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The Space Right to Food & Guarantees

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Private space flights have raised significant legal concerns regarding the granting of fundamental human rights to non-astronauts under international law, including appropriate legal guarantees. This study focuses on one area of non-astronaut rights and guarantees designed for food. The need for an international legal statement on what non-astronauts can expect regarding their right to food and the guarantees they are entitled to, even when flying into space, is justified with experimental data. The author seeks to establish a distinct set of space rights and guarantees that build space tourism's best service accompanied by a fundamental human rights legal core. This will ensure that non-astronauts are afforded the essential legal protection necessary for them to fully experience and uphold happiness during their space journey.

*Keywords***:** *human-manned commercial space flights, space tourism, non – astronauts, space nutrition, food consumption.*

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Introduction

The tradition of presumption recognizes that happiness is something that people experience (Dutta & Mandal, 2021: 44). The architectural factors of the state of space significantly differ from those on Earth, but the fundamental experienced conditions for human well-being stay the same. Humans rely on high-quality, well-balanced, and delicious food to maintain their health and vitality. According to the research vision, food plays a vital role in ensuring happy habitability in isolated spaces. Furthermore, it is a critical facet of the thriving colonization of space. Following six decades of development, the technology of launch vehicles has progressed with respect to the dual action of demand traction and technical promotion, providing increasingly valuable high-tech services for society (Autonomous, 2023). Regardless, the study considers that any economic activity, even if it benefits humanity, must have specific restrictions to prevent abuses being necessary for the desire of the global mass of people to fly into space to affect the orbital sphere of space positively (Bulgakova, 2020a). As a result, the autonomous

conservatories would become increasingly apparent. Indeed, they differ substantially from what we are inured to on Earth and depend on various environmental characteristics, including gravity formations, microclimates, and the utilization of known soil, recyclable biomaterials, and the role of international law to shape these challenges. Factually, developers must adhere to legal norms when offering space journey-fly packages and competitive projects, providing the best service possible to customers. This service includes the offer of properly prepared menus to satisfy human hunger during a stay on Mars, the Moon, the International Space Station, or in non-gravity settings for the happiest experience. However, these measures are implemented only on a narrow basis and are relatively straightforward and tailored to trained professionals in space travel disregarding the appetite of non-astronauts'.

Truly found, today's consumer seeks happiness rather than satisfaction (Dutta & Mandal, 2021). Therefore, in addition to the nutritional and life support system applications, the design of space food shall guarantee not only the well-being of the space flight participants but also prioritize the consumer mindset of perspective space tourists. Such habitability-related concessions can be achieved through the foundation of standpoint space rights where the right to space food with further guarantees on enhancement countering the otherwise technical and monotonous spacecraft environment shall contribute to the benefits of human-manned commercial space flights by creating a sense of legal protection for the happy-satisfactory food appliances, allowing participants of space flights to witness their joyful growth and optimistic shift within a journey. Traditionally, the practice of innovations strength, such as developed food prototypes for remote journeys (Mok & Oehlberg, 2017), digital food fabrication (Mueller & Peek, 2016), food by computing devices (Obrist et al., 2018), food-simulating substances (Salamon et al., 2018), artistically made food (Schifferstein et al., 2019), SpaceFood X (Space Food X, 2019) are in the top set of the food industry maturation. Within this tradition, happiness is associated with achieving a set of factors that are believed to be relevant to achieve happiness (Dutta & Mandal, 2021: 44). It is because these developments represent a significant strive for the legal course oversight of the satisfaction of perspective space tourists' consumption checklist of concerns since the lack of legal guarantees potentially could affect journey achievements in happiness, and thus requires urgent attention. If long as the market offers a variety of edibles, it is the target for the research to find out that consumption checklist of concerns and regardless to propose for the international community to sum up the presented specifics and take appropriate actions toward recognition of distinct space right to food with the implementation of trend along guarantees affecting happy-related approach that this research undertake.

For the protection of customers' interests, rights, guarantees, and physiological happy-mood satisfaction, as well as to prevent violations and restrictions in the delivery of space food products, it is proposed attention be paid to recognize the space right to food with guarantees relevant to before, during, and after consumption. To date, most studies on space food and related laws have focused on "earthly" food, and there has been a lack of systematic theoretical research on the perspective of space tourists' experience of food consumption in space with appropriate legal guarantees. This is an important issue that should not be underestimated. For instance, according to Ruut Veenhoven (Veenhoven, 2021: 235), to date, there is only one study on the effect of an induced change to a healthier diet on an individual's happiness. In this study, people were randomly assigned to an experimental group and stimulated in various ways to consume more fruit and vegetables (FV), among other things by providing vouchers for healthy foods and sending e-mail reminders. After two weeks of increased FV

consumption, the participant's mood levels had increased more than those of the control group. Additionally, the proposed "happy" ground vision would provide surrogate views having a window to living organisms such as greenhouse techniques with portable plant cultivation subsystems that allow participants of space flights to have personal plant-growing setups leading to the best happy service and enhancing at the same time the happy standard of life in isolated environments. Moreover, alongside the serviceable design of microgravity kitchens and utensils for long-term assignments, personalized and flavorful menus created from freshly grown ingredients prepared on board with recycling features, also guarantee the happiness level in self-sustainability. Indeed, self-sustainability is not inflexible to food display and recycling alone; it is also binding for the success and safety of a longer-term journey. Hence, committing self-sustainability becomes a prerequisite for the conquest of human well-being in space, enabling space flight participants to feed themselves without relying on shallow assets. Consequently, with this guarantee, individuals who are unprepared and unaccustomed to the rigors of space travel may also embark on these flights.

Research methods

This breakdown is a portion of research about space life reinforcement staying for the recognition of distinct space rights for the "consume happy" practice food systems that bring an individual to self-sustainable guarantee during human-manned commercial space flights known as space tourism or private space flights.

The experimental research methodology acknowledges the preferences and concerns of potential consumers (space tourists) with the goal to come up with ideas for new food product guarantees and service features. The informality of collected data outstrips social indicators to have structured and up-to-date respondents' points of view. The empirical results have a hint character to help out lawmakers in identifying ideas, categorizing perspective clients' (space tourists) opinions about research striving themes, placing courses for innovators, and filtering out the most common thoughts through the idea mining grouping method. Thus, through the questionnaire, the research manages open kinds of answers tasks where a potentially considerable large group of perspective space tourists is in charge of giving their own view. As a result, related decision processes are configurable, likewise, by defining the most adorable right to grant with further realization, and by letting know to which extent this right is divined to be guaranteed during human-manned commercial space flights.

The author argues that international legal standards for space nutrition should be developed specifically for non-astronauts, as they are space tourists and cannot be likened to the same food standards as professionals. This statement leads to protect the interests of space flight participants and carry out their space health and happiness satisfaction. Accordingly, by examining recent advancements in space-food interaction design, the author rises the discussion about the correlation of gotten results with the potential nutritional imbalances that could arise from consuming space food by non-astronauts. Hence, the study proposes tips for the maintenance of order in space nutrition. The study also emphasizes the need for developers and international space organizations, space food project innovators, theorists and researchers, and lawmakers to address the phenomenon of the space right to food & guarantees practically implementing, including the urgency to establish specific service-level acts on international food standards for space tourists and shows the overall necessity in international space food law dedicated to human-manned commercial space flights. Hence, this study demonstrates how

international law can be utilized to co-create innovative concepts that balance both the specific happiness-related concern and outer space conditions where food availability is limited.

Empirical results toward realization checklist

It is natural for individuals to place great importance on their daily diet, food consumption, and enjoyment for happiness pride. The strive that delights the research call is about the proposal in recognition of singular space right to food & guarantees. Empirical research is proven that reach whereas social indicators are necessary to emphasize and promote the urgency of the respective legal process. The author run a social questionnaire to present the top concern of the space journey checklist fulfilled from October to December of 2019 within the Earth–Space–Earth Trip (ESE) scientific research project at the Faculty of Law of the University of International Business and Electronics (Beijing, People's Republic of China). The survey called the ESE Questionnaire (ESE Q), included responses collected through an online platform Jinshuju and personal interviews (in total 451). During the questionnaire, the author revealed the following problems of food needs in space that acquire satisfaction (Bulgakova, 2020a: 64). Specifically, the survey aimed to gather opinions on the right and guarantees that probable non-astronauts believe they should prioritize during space journeys. The results of the survey were analyzed and presented by analogy to Maslow's pyramid of human needs (Maslow, 1943). Respondents from Africa, Asia, Australia, Europe, North America, and South America were asked to imagine themselves as potential space tourists or non-astronauts of private space flights and respond to the questions without any variable choice. Figures present the recapitulated upshots of responses bonding research specifically to food reference, obtained from the preliminary estimation to question No. 7 of the ESE Q.: "7. Which rights should be granted to you during Space journey?", No. 8: "8. Which guarantees should be provided to you during the Space journey?" The display of derivatives does not demonstrate a statistical ratio concerning the geographical zones of respondents or in comparison to other recognized rights and related guarantees. Instead, it presents the percentage (scaled from 100% in each figure) of the most observed reaction towards rights (refer to Figure 1) and guarantees (refer to Figure 2). Consequently, the figures function as a concise representation of a favorable (positive) social indicator. These figures strongly emphasize the pressing need for the implementation of legal measures to secure the fulfillment of space rights and underscore the critical importance of acting both within the emerging jurisdiction of space, which falls under international enforcement, and within the broader realm of international law with admiration to food.

Figure 1 sheds light on the outcomes of Q7, which focuses on the necessary legal regulations concerning the space rights of non-astronauts during private space flights. Notably, the "Triangle of the Space Right to Food" highlights the significance of formally recognizing space rights, as evidenced by the 60% of respondents who directly expressed their support for the "Right to Food" as a crucial space right.

Shifting our focus to the experimental evidence, Figure 2 "Triangle of the Space Food Guarantees" provides a visual representation of the manifold spectrum of responses obtained in accordance with the prevalent comebacks amassed from Q8 of the ESE Q. The majority of respondents (80% on a 100% scale) expressed the crucial importance of legally ensuring warrants for space food. The pinpointed top food stakes also included anxiety about nutritious meals, three meals a day, want health risks, safety, and high-quality standard of a menu.

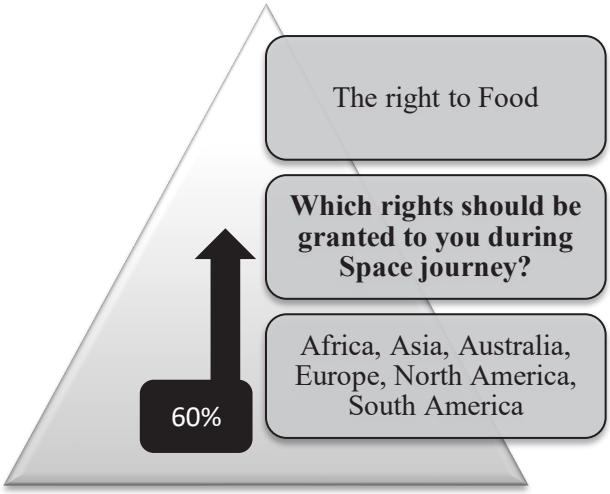

Figure 1. Triangle of the Space Right to Food

Figure 1: The social indicator signifies the legal importance of conferring the Space Right to Food for non-astronauts during private space flights.
Source: Composed by the author Daria Bulgakova

Accordingly, it becomes apparent that over half of potential space tourists have concerns regarding the legal status of space rights to food and the corresponding guarantees during their journey. The juxtaposition of Figures 1 and 2 underscores the need for focused attention on the development of space tourism services concerning guarantees for space food. Respondents exhibited varying viewpoints and uncertainty regarding these guarantees. Some suggested that the right to food should be included as a standard component of space tourism services, while others advocated for its legal mandate and practical enforcement as a fundamental human right. However, it should be noted that incorporating guarantees for space food may introduce further legal complexities, not only in terms of regulation but also in terms of certification and adherence to legal standards. The collective findings suggest a link between human physiological and well-being needs, international human rights, specific space rights to food for non-astronauts, and the corresponding legal guarantees.

The present study advocates the recognition of the right to food, which holds significant importance in international human rights frameworks. It is enshrined as a vital aspect in the Universal Declaration of Human Rights (1948) under Article 25, as well as in the International Covenant on Economic, Social, and Cultural Rights (1966) as part of the International Bill of Human Rights, encompassing various other provisions. Additionally, regional agreements, such as the Protocol of San Salvador (1988), an Additional Protocol to the American Convention on Human Rights, include specific provisions on the right to food in Article 12 and Article 17. National constitutions in many countries also recognize the right to food. Various international treaties, including the Convention on the Rights of the Child (1989), explicitly acknowledge the right to food for individuals across different regions, outlined in Article 24 and Article 27. Also, Comment No. 12 by the Committee on Economic, Social, and Cultural Rights (1999) provides

Figure 2. Triangle of the Space Food Guarantees

Figure 2: The social indicator signifies the significance of the top five Guarantees of Space Food for non-astronauts during private space flights.
Source: Composed by the author Daria Bulgakova

an in-depth understanding of the right to food, which remains fundamental in international law. International human rights law recognizes the right to adequate food and freedom from hunger as a fundamental human right applicable to all individuals, irrespective of their race, color, sex, language, religion, political or other opinions, national or social origin, property, birth, or any other status, as stated by the UN Human Rights (2010). Therefore, the right to food in the context of space travel pertains to the entitlement of participants to access safe, nutritious, and satisfying standard food during their journey under international law. Hence, taking into consideration mentioned, the article also accentuates the differentiation between the right to food and the space right to food presenting a comparative Table 1. The author stresses, that the table is speculative and intended solely to illustrate potential distinctions between two categorizations.

Table 1. The Right to Food VS The Space Right to Food Checklist

#	Criteria	The Right to Food	The Space Right to Food
1	Origin	Congenital	Obtained
2	Basis	Fundamental	Specific and coming from Fundamental
3	Acquisition	Comes from birth	Comes from the legal relationship
4	Irrevocability	Inalienable	Alienable
5	Status	It does not require a status	Requires non-astronaut status

6	Duration	Never end	End with the completion of space flight and (or) the end of the legal relationship with the food service provider
7	Choice	Unlimited	Limited to a specially designed food ration and the number of days of space flight, restricted by the obligatory schedule, mission regime
8	Territory	Food consumption experienced on Earth does not exclude other areas	Food consumption experienced in outer space conditions
9	Enforcement	It is enforced both at the national level and the international level	It is not enforced either at the national or international levels
10	Policy	The policy has been regulated by both national and international authorities	International authorities have regulated the policy
11	Protection	It is protected under national and international law, legal instruments	It is protected under international law first, and national law is supplementary
12	Intervention	If a person cannot feed himself, states authorities may provide a resource	A person uses service-level resources from third parties

Table 1: A comparative table with differentiates between the right to food and the space right to food.
Source: Composed by the author Daria Bulgakova

Additionally, the author underscores the significance of categorizing the space right to food as a distinct subset of rights and advocates for its regulation not only as a part of service level agreement corresponding to space tourism but also for the prioritization of the humanitarian impact by shedding description on the next criteria:

1. *Origin:* The right to food is an inherent human right, whereas the space right to food is derived from the principle of space mission origin. While the right to food is charged to human rights essence applying universally to all individuals, the space right to food is derived from the unique context of space tourism service to so-called space tourists and is specific to the challenges of space exploration and limited in extent.
2. *Basis:* The right to food is established on the broader foundation of international human rights encompassing fundamental insight. At the same time, the space right to food is emanated from the prior framework taking into account the distinct characteristics and prerequisites associated with food proportionally to the space assignments. This recognition is required to discourse the unique challenges and considerations involved in supplying bearable sustenance of space tourism.
3. *Acquisition:* The right to food arises from birth, while the space right to food is acquired and has nothing to do with the moment of birth but is related to the

physiological needs in means of Maslow's hierarchy of needs actual in space as well.

4. *Irrevocability:* The right to food is irrevocable, whereas the space right to food is contingent upon the completion of service-level agreements with the food provider party throughout the duration of the space journey. Once these agreements expire or are completed, the food guarantees cease to be executed.
5. *Status:* The space right to food is only possible upon participation in space tourism given to such a person-specific status of a participant in a space flight respectively. The general right to food does not require any status irrespective, and everyone enjoys the freedom of this right without prejudice.
6. *Duration:* The right to food always exists due to an enduring entitlement, whereas the space right to food ceases to be effective when the space mission is completed and/or when the legal arrangement with the food service provider is terminated and comes to an end.
7. *Choice:* A person has the freedom to choose what and when to eat with the right to food, while the space right to food is restricted to a strict schedule and a specific diet developed for space flight. It means the right to food annuities individuals the freedom to choose their meals and eating schedule according to their preferences. Contrariwise, the space right to food is subject to severe schedules and exhaustive diets organized for space travel and could be modified to a predetermined regimen.
8. *Territory:* The right to food is often practically realized with the link to the place of residence and a respective minimum living wage, while the space right to food is limited in realization due to a specific outer space environment.
9. *Enforcement:* The right to food is enforced by national and international regulation measures, while the space right to food is subject to specific distinct happiness-alike enforcement measures tailored to deliver the best expectations with dining options and culinary juice during space travel.
10. *Policy:* Policy formulation is a political process and does not proceed based on available scientific evidence alone (Ashley, 2018: 80). The space right to food is subject to space tourism policy governance, and the right to food is subject to worldwide policies.
11. *Protection:* The space right to food is protected by specific legal instruments related to space missions and the lack of a strong cure, while the right to food is protected by human rights law with immediate remedies and redress.
12. *(State) Intervention:* A person may receive resources or free food from state authorities for social and economic reasons under the right to food. However, this is not eligible with the space right to food since the food is a cost that shall be covered together with the potential service fees. The space right to food operates under a dissimilar context with foreseen financial support to equip nutrition.

Consequently, the state of the results is the need to regulate the tailored right and allocate it to a specific group to confirm space tourists' legitimate interests because the right to food is not just about guarantees in minimum calorie or protein requirements, but it is also access to all necessary nutritional items vital for a healthy and wholesome life to meet their Maslow's hierarchy of needs and to cater individual requirements in terms of happy end of space travel.

Research discussion toward implementation specifics

Developing appropriate legislation to regulate space food is a critical first step for any private space flight program. International law plays a crucial role in addressing micronutrient deficiencies, particularly in fortified foods. International regulations can help ensure that the space tourism industry supplies adequately fortified meals that meet an individual's dietary needs based on supplementary factors such as age, health, occupation, and sex. Thus, the human endocrine system plays a crucial role in providing space tourists with essential services such as prepared meals under the legal protection affected by the unique conditions of space flight. The effects of space travel on human hormones, such as epinephrine and cortisol, can lead to modifications in metabolic processes that impact glucose, fatty acids, and glycogen content (Popova & Grigoriev, 1994). Previous missions have shown an increase in catabolic hormones and prolonged metabolic stress responses, influenced by various factors such as energy intake, exercise, and gender (Stein & Wade, 2001). Fluid balance is also affected by hormones like catecholamines and renin-aldosterone, leading to sodium retention without fluid retention (Drummer et al., 2000). However, given that space tourism is open to the public, it is crucial to consider the modernity of technology and the potential health risks for non-astronauts' self-sustainability. Although those tourists are undergoing a medical and physical examination, they may not have the same tolerance for certain food and substances under the influence of gravity. As the multiple causes of undernutrition are "structural," so they need redress in a "structural" way (Ashley, 2018: 83). Therefore, lawmakers should prioritize the protection of tourists' health by implementing reliable test processes to identify endocrine disruptors and manage them appropriately based on reliable experimental results in cooperation with medical institutions.

Space food presents unique challenges in servicing balanced nutrition for human beings in zero-gravity environments while ensuring that the food is legally safe and could be on sale and consumed. Maintaining equicaloric intake during private space flight involves addressing factors such as vitamin requirements, physiological changes in taste and satiety, scheduling issues related to meal preparation and consumption, food quality, regulatory standards, and availability (Smith & Zwart, 2008). In addition, many space food scientists believe in sustainable and convivial space habitation that requires a readiness for a supply of food that does not have to be transported from Earth (Häuplik-Meusburger, 2015). This means that different living conditions and occupations, such as space stations on Moon, Mars, and beyond require specific dietary needs and rations. Given these challenges, there is a growing legal concern about public space health to ensure that standards are tailored to the unique requirements of space food and are not simply an extension of existing food policies.

The article spotlights the efforts of the United Nations Office for Outer Space Affairs (UNOOSA) in developing international safety standards for space food. However, there are concerns about the applicability of current International Food Standards (IFS) in outer space due to modernized changes and enforcement issues, as Samuel Godefroy noted in his research (Godefroy, 2016) suggesting IFS should be a guide for standardizing food products globally and highlights the special role of the Codex Alimentarius Commission in food security. The author agrees with Godefroy's opinion and implies that IFS could be spread in inventing and modifying the law on space food for long-distance space travel. However, given the unique circumstances of space tourism, the author proposes that specific standards for space food should be developed, implemented, and enforced through international space food standards

(ISFS). Such standards would ensure the right to food in space and guarantee the safety and standardization of food for space tourists with limited supplies calculated for the duration of the trip and for individual dietary needs. To prevent possible negative consequences caused by poor-quality products, ISFS should assess the specifics of space travel and the preparation and consumption of space food defined within IFS with respect to the need for daily replenishment of necessary minerals and supplies. Such standards would promote consumers' healthcare and decrease obstacles.

Consequently, the following back-and-forth is accentuated. Firstly, the demand for nutritional space food for non-astronauts and nutrition is crucial in individual microgravity acclimatization as any technological arrangement of the spacecraft. Secondly, there are significant differences in diet and health requirements taken on Earth and space due to the unique conditions of human spaceflight. Defining nutrient and diet requirements for extended periods in microgravity is necessary to address these unknowns. Given the legal complexities, thirdly, environmental factors such as space radiation, space shuttle, and spacesuit pressure can affect the nutritional status of space food supplements. Fourthly, more extended missions to the Moon and Mars, with their low gravity, can further compound the situation and increase the risk of nutritional deficiencies. Finally, modified ration intake may be necessary to neutralize or alleviate the adverse effects of spaceflight on the human body. As such, future goals for nutritional resistance should be established to improve space food's persuasiveness and guarantee well-being. Therefore, ISFS must be developed to address the need for specific nutrient and diet requirements, environmental impacts, and mission duration.

With the increasing service of technological substitutes for food, human rights supporters must pay attention to the machine-made nature of these food products designed for non-astronauts, as opposed to natural food sources. To establish the need for specific standards for space food, it is crucial to underline the specialized advancements in space food production, such as 3D printing technology (Khot et al., 2017). It is consequential to remark that such refinements in space food display bring potential concessions and hazards. Indeed, the production of space food in 3D allows for the creation of customized and nutrient-rich meals that meet specific dietary requirements. However, there are potential health risks associated with the continuous consumption of 3D-printed space food. Similarly, as technology advances, it is compulsory to evaluate the ethical implications of relying on machine-made food rather than natural food sources.

In order to address the unique characteristics of space gravity, the author recommends that standard categories for space tech food products be included as a significant part of the ISFS. As the origin of cosmic food is often through technology rather than natural inputs, it is important not to overlook the presence of critical nutrients like calcium. It is essential to adopt appropriate laws that regulate standards for technically derived space food to prevent oversight. Calcium and its effects on skeleton metabolism should be of particular interest to lawmakers since as the research has shown, space flight causes increased bone absorption and effectively unchanged bone formation, resulting in the loss of calcium and bone mineral (Sibonga, 2013). Also, the technical side of the released 3D print space food shall operate under the protection of the patent, and the product label acts as a distinctive category falling under the protection of trademark law, which in turn allows space tourists to identify the space object as a source (Bulgakova, 2020b). This, in turn, alters the endocrine regulation of calcium metabolism, making it crucial to ensure that space food meets diverse nutritional needs. Furthermore, several biological components are crucial for maintaining healthy bones together

with calcium such as vitamin D. After consuming a meal with calcium, the digestive tract absorbs and sends it into the bloodstream. However, during spaceflight, calcium absorption from the intestines decreases, even if astronauts or non-astronaut crew members take calcium supplements, which leads to bone loss (Smith et al., 2012). Furthermore, sodium intake is also a concern during spaceflight, which is why space diets contain more than the usual sodium amount. However, increased sodium consumption can result in elevated calcium excretion in urine and an increased risk of developing kidney stones. To address bone health in spaceflight, it is essential to establish optimal dietary standards and guidelines that must be enforced. Therefore, this article emphasizes the importance of meeting the specific calcium and sodium needs during spaceflight and the significant losses of these elements, which necessitate the development of optimal dietary standards for space food that account for biodiversity and genetic resources. To establish these standards, experts should study the regularity of bone harm during spaceflight and develop international legal standards for space food testing that mitigate bone loss. At the same time, another issue that requires further research and legal regulation is the cardiovascular health of space travelers and their adaptation to nutrition during space flight (Zhang, 2013). For example, although Omega-3 fatty acids have been shown to profit cardiovascular health on Earth, this benefit has yet to be analyzed in space. An effort to grow Omega-3 fatty acids in astronauts' diets through the consumption of caustic fish may have potential benefits on other body systems, such as bone and muscle health (Rizos et al., 2012).

International organizations play a crucial role in developing international norms and rules for space food to ensure no gaps or potential negative impacts of products and consumption on the human endocrine environment. In the realm of product testing for endocrine system effects, including those resulting from space activity, it is crucial to focus on the Organization for Economic Cooperation and Development (OECD) activities. The OECD has published the Revised Guidance (2018) on Standardized Test Guidelines for Evaluating Chemicals for Endocrine Disruption, which is of paramount importance. This document applies to the development and testing of space food, as it features a universally accepted meta-methodology that applies to various food-related fields. It addresses the impact of food products in toxic environments, which is also relevant to the space environment. The document proposes about fifteen possible forms of toxicity that should be employed when examining the impact of space on a person's endocrine system while consuming food. Furthermore, the Convention on Biological Diversity is proposed as a crucial international document for addressing the issue at hand. According to the convention, biological diversity encompasses the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems, as well as the ecological complexes of which they are a part (Article 1). It defines genetic resources as a material of plant, animal, microbial, or other origins containing heredity units (Article 2). However, when it comes to food, neither its diversity nor its resource content can be adequately captured by these definitions. While biodiversity is essential for all biological systems, the relationship between genetic resources and bone health is more systematic and significant than its correlation with other bodily systems. Therefore, there is a need for a more nuanced approach to regulatey the diversity and resource content of food in space.

To ensure the well-being of space travelers, it is important to enrich their diets with essential nutrients. The General Principles for the Addition of Essential Nutrients to Foods Codex (Codex Alimentarius Commission, 1987) define fortification as the addition of necessary nutritional components to food items, regardless of whether they are customarily found in the food, to prevent or correct nutrient deficiencies. Food fortification is already being used to address

deficiencies in vitamins A, D, and E, as well as calcium, iron, phosphorus, and vitamins A, B, C, and D worldwide (Mozaffarian et al., 2018). However, any fortification added to space food should maintain its nutritional characteristics and quality without substantially altering its flavor, assimilation of nutrients, or reducing its safety with at least twenty-two mineral elements required for human well-being (Samoraj et al., 2018). It is important to continue exploring additional ways to enrich diets to maintain health and well-being during space missions.

The examples provided illustrate the need for a thorough examination of the legal implications and gaps, especially in cases where negative consequences may occur. Additionally, a comprehensive approach to food data should cover a broad definition of food accessibility to ensure space tourists are informed about the food they consume. The availability of space food is also an essential factor to consider, with the need to maintain the immune system of individuals who have flown into space. Changes in diet during space flight can lead to a violation of nutritional balance and negatively affect the immune system. To address this, a system of providing a vitamin complex is proposed, including the preferred vitamin complex in a menu. Therefore, the implementation challenges of the space right to food & guarantees are required to maintain space travelers' immune systems and ensure food components availability and safe consumption.

Conclusions

As space technology advances, it raises important legal questions regarding the rights and guarantees of individuals – space travelers. One significant challenge is ensuring that adequate food standards are provided for private space flights, taking into account the unique physiological needs of each person in a zero-gravity environment. To address these challenges, it is necessary to establish a specific set of rights for non-astronauts under international human rights law, with a particular focus on addressing gaps in food regulation. Designing food systems for space missions is a complex task that involves the cultivation, care, harvesting, and processing of food. This is because microgravity can affect individual nutrition-related characteristics, such as the skeletal and circulatory systems.

The space tourist leads not only to meet basic needs to satisfy hunger, but also there are happiness-relating needs to have visually appealing food which is easy to prepare and store, tasty, capable of retaining its quality over time and recyclable donating to sustainability in the space domain. Besides, current nutritional requirements for private space missions are based on limited research with links to trained astronauts, thus, further assessment is to ensure the health and happy-alike well-being of space travelers. To achieve this, international legislators should collaborate with medical and space institutions to thoroughly analyze the specific requirements of space food. This will provide verified data to inform the development of future space travel. It is necessary to establish explicit standards and regulations for space food tailored to each space tourist's nutritional needs and preferences, considering the limited access to food during the trip and the potential risks associated with the consumption. To bridge the gap in international regulation, the discipline of international law should work in conjunction with other relevant disciplines to address the specific challenges of space food and develop comprehensive policies. Medical evaluations, biochemical assessments, and dietary considerations should be incorporated into the legal implementation of space food regulations and assessments of countermeasure measures.

Although there is experience with space tourism, international law requires confidence evaluation in the human organism's ability to readapt to the space environment during private space flight. For instance, the research has shown, the effects of prolonged journeys have led physicians to conclude that regulation is necessary to mitigate the adverse physical and psychological impacts of the space environment on space tourists. This is essential for non-astronauts to safely enjoy private space flights. One of the most significant global challenges facing space nutrition is mineral deficiencies, which is a surmountable subject to the discourse of potential radiation through daily micronutrient intake. The theoretical doctrine also argues that space food must have modifications in diversity and mineral content, considering the specifics of natural origin and technical requirements. This will secure that all space tourists can safely enjoy their journey while also protecting their statement of the body. Unlike professional astronauts, space tourists are not experienced in space exploration, and their well-being is at the center of legal concern for this new industry service. To confirm the success of private space flight exploration, the recognition space menu for human-manned commercial space flights is crucial. Future research needs to critically analyze and establish guidelines for essential areas of nutrition and international food law science together with a productive legal system for international regulation of space rights, particularly the space right to food and guarantees. This directs the collaboration of various disciplines, including and not limited to physiology, horticulture, psychology, advanced medical technology, diagnostic testing, food science, and biochemistry.

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Challenges of Public Administration of Production of Short-Range Ballistic Missiles in Ukraine in the Context of Full-Scale Invasion of Ukraine by Russian-Terrorist Forces after February 24, 2022

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The article identifies challenges of public administration of the production of short-range ballistic missiles under current conditions. It is emphasized that Ukraine has created good legislative conditions for the start of design, testing and acceptance of weapons. The authors propose that the Government of Ukraine should provide state guarantees to rocket and space industry entities for loans from banks and for attracted investments that will be used for the development and testing of short-range ballistic missiles. The authors reveal a positive role of private entities in the rocket and space industry, which brings a positive competition to this area and reduces the cost of developing and producing of Ukrainian short-range ballistic missiles for the Armed Forces of Ukraine.

Keywords: competition, deterrent weapons, financial guarantees, financing, public administration, short-range ballistic missiles, russian terrorists.

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Introduction

After the start of the full-scale invasion of Ukraine by the russian-terrorist forces on February 24, 2023, the issue of establishing the production of short-range ballistic missiles has become a priority. This is not to say that this problem is new and Ukrainian missile builders had to start from scratch. For many decades, Ukraine was one of the leading space powers in the past, designing and producing large numbers of medium-range military ballistic missiles and intercontinental missiles. In the first decades of Ukraine's independence, Ukrainian designers and engineers made a significant contribution to launching dozens of satellites for various purposes into Earth's orbits using their own missile boosters, which were taken off combat duty. However, Ukrainian rocket scientists did not produce their own short-range missiles. And Ukraine's voluntary international commitments do not allow it to continue developing medium- and long-range missiles.

At the same time, the aggressor state of Russia has a line of modern short-range ballistic missiles such as Iskander and Kinzhal. And several types of cruise missiles with a range of up to 5500 km. These are successfully being used on the territory of Ukraine. And in most cases, they are used against civilian objects, killing and injuring thousands of Ukrainian civilians. Russia's advantage in ballistic and cruise missiles is absolute. At the beginning of the war Ukraine's armed forces were limited to the range of the old Soviet Tochka-U systems (up to 120 km).

From the beginning of the full-scale invasion up to April 5, 2023 Russia has used up about 4,750 missiles of various ranges to strike upon Ukraine (Datsenko, 2023). According to the UN, the number of civilian casualties from February 24, 2022, after Russia launched a full-scale war against Ukraine, up to May 1, 2023, has amounted to 23,375 people, including 8,709 deaths (The war, 2023). There is no data on direct deaths caused by the Russian ballistic missiles. However, this is a significant part of the mentioned above statistics. To give just one example, on July 9, 2022, the Russian terrorists fired Iskander ballistic missiles at high-rise buildings in the town of Chasovyi Yar, Bakhmut district, Donetsk region. The missiles struck residential buildings. Forty-eight bodies were recovered from debris, including a 9-year-old boy who had died with his mother (Berezhnyi, 2022). Unfortunately, this is just one of dozens of cases of the Russian terrorists killing civilians in Ukraine with ballistic missiles. Despite the international sanctions, Russia retains its potential to produce modern ballistic and cruise missiles.

As of July 1, 2023. Ukraine has not yet begun production of its own ballistic missiles in order to deter Russian terrorists. The authors are not aware of any information gathered from open sources whether some development of a Ukrainian short-range ballistic missile is being successfully carried out.

In response to Russian missile terror, the Ukrainian government and volunteer organizations took the easiest way out. They began purchasing foreign weapons and setting up the production of Ukrainian drones. In the short term, this was quite a prudent step. However, if we look at this problem in the medium term, especially from a more strategic perspective, there are significant shortcomings within public administration of public production of short-range ballistic missiles in Ukraine in the context of the full-scale invasion of Ukraine by the russian-terrorist forces on February 24, 2023.

As the guarantor of the Constitution of Ukraine, the President proposed the five main guidelines for the national discussion of the Ukrainian Doctrine. These guidelines include the philosophy of our victory; the global nature of Ukrainian security; transformation in 10 years, including education and science, culture, and a level of security and freedom in Ukraine. These, according to the President of Ukraine, may be disclosed by certain specific items that the nation determines to be important (Zelenskyy, 2023). In our opinion, the above-mentioned guidelines should be disclosed for the subject of our analysis, i.e., the creation of effective and reliable ballistic missile deterrence against the aggressor based on Ukrainian developments.

Thus, in accordance with its international obligations, Ukraine is able to design and produce only short-range missiles up to 500 km for domestic use and up to 300 km for export. For this purpose, Ukraine has design and a certain production potential. In our opinion, this is not being done in the context of the full-scale invasion of Ukraine by the russian-terrorist forces, solely because of the short-sightedness of the officials (possibly done on purpose by the russian agents in the ranks of the Ukrainian bureaucracy) who are responsible for public administration over development and production of ballistic missiles to deter the russian aggressor.

Why does Ukraine need its own short-range ballistic missiles?

Today, the Armed Forces of Ukraine have significantly more weapons, both in quantity and quality, than before February 24, 2022. The combat missiles are no exception either. A number of various types of military missiles in missile systems are being delivered to Ukraine. They are on combat duty and are successfully being used. HIMARS (High-Mobility Artillery Rocket System) is a multiple-launch rocket system. It was developed in the 80s of the last century. The cost of one system is $2.3 million. The US Army used it in Iraq in 2003 and during the Gulf War. HIMARS missiles are very diverse. Those supplied to Ukraine hit the aggressor with an accuracy of 3 meters with a warhead weighing 90 kg (Makalyuk, 2022).

A year ago, HIMARS significantly improved the effectiveness of military operations by the Armed Forces of Ukraine. Now they remain a leading artillery force of the Armed Forces of Ukraine for destruction of manpower and of the lightly armored moving and non-moving objects of the aggressor. The disadvantages of HIMARS include its low power of the warhead and a short range of the missiles supplied to Ukraine. In addition, there is information that the enemy sometimes manages to interfere with the radio guidance system, which deflects the HIMARS missiles from their targets (The Missiles, 2023).

The authors express their deep gratitude to the American people and the US government for supplying HIMARS missile systems to the Ukrainian Armed Forces. They have greatly

enhanced the firepower of the Armed Forces of Ukraine and made our path to our victory less sacrificial.

In early May 2023, Ukraine received long-range Storm Shadow/SCALP missiles from the UK. These are Storm Shadow air-to-ground cruise missiles, a clever modern development of Britain and France. They are considered particularly effective in destroying enemy's logistics. The warhead is a container with a sub-caliber warhead of about 450 kg with a killing radius of 200-300 km, which makes it possible to destroy stationary targets reliably protected by air defense systems (Storm, 2023).

The authors express their deep gratitude to the people of Great Britain and France and their governments for supplying the Armed Forces of Ukraine with Storm Shadow missiles. We are convinced that they will significantly enhance the combat capabilities of the Ukrainian army. However, it should be noted that these missiles are air-launched. The Ukrainian carriers (boosters) of such missiles are of Soviet origin. Without the Western F16 aircraft, the effectiveness of Storm Shadow missiles is rather reduced.

HIMARS and Storm Shadow missile systems have some common drawbacks. There is something to it because the governments of the countries of their manufacture do not allow the Ukrainian Armed Forces to use them on the territory of Russia. This is despite the fact that virtually all missiles striking Ukrainian citizens (noncombatants) and civilian infrastructure are launched from the territory of Russia, which is recognized by the international community. Thus, the missiles provided by our partners and allies today and in the future will not become a deterrent to the aggressor. The Armed Forces of Ukraine need Ukrainian missiles to deter the Russian aggressor on its territory.

Legislative regulation of public administration of production of short-range ballistic missiles in Ukraine in the context of the full-scale invasion of Ukraine by the russian-terrorist forces on February 24, 2023

After the start of the full-scale invasion of Ukraine by the russian-terrorist forces on February 24, 2023, the legislation regulating the subject of our analysis has been significantly and, in our opinion, positively updated.

The first thing to note is that the special Law of Ukraine "On Licensing of Economic Activities" lists only the production and repair of non-military firearms and ammunition as types of economic activities that are subject to licensing (On licensing, 2015). As it is well known, the list of the types of economic activity that are subject to licensing is exhaustive in the analyzed special law.

Thus, the production of domestic weapons, including ballistic missiles, is not a subject to licensing in Ukraine.

This economic activity is regulated by another specialized law, namely the Law of Ukraine "On Defense Procurement," which defines a general legal framework for planning, the procedure for determining a scope and specifics of procurement of defense goods, works and services to meet the needs of the security and defense sector, as well as other goods, works and services to ensure a guaranteed provision of security and defense needs, as well as the procedure for exercising state and democratic civilian control in the field of defense procurement. The Law stipulates that the procedure for development, mastering and production of the new types of defense products, as well as the termination of the production of existing types of such products, shall be approved by the Cabinet of Ministers of Ukraine (On defense, 2020).

Thus, the design, testing, and production of ballistic military missiles in Ukraine is carried out on the basis of a bylaw.

This act was approved by the Resolution of the Cabinet of Ministers of Ukraine dated as of March 3, 2021, No. 234 "Procedure for design, development and production of new types of the defense related products, as well as termination of production of existing types of such products." According to this act, a decision on the development of a sample, which is being developed in the interests of two or more state contractors, shall be agreed upon by all the interested state contractors on the basis of an advanced design.

In order to make a decision on the development or modernization of a prototype, scientific and technical expertise of the tactical and technical (technical) task for research and development work may be carried out at the initiative of the state customer in accordance with the Law of Ukraine "On Scientific and Scientific and Technical Expertise." If a decision is made to develop a prototype, a state customer submits proposals to the Ministry of Strategic Industry for development of such prototype to the three-year procurement plan for the defense-related goods, works and services and/or a consolidated three-year procurement plan for defense related goods, works and services under a closed procurement. A decision to initiate research and development work shall be made by a state customer, taking into account some conclusions of the scientific and technical expertise of the tactical and technical (technical) task for the research and development work conducted by the main research institution of a state customer. In the absence of such an institution, the said decision shall be made taking into account the results of consideration of a tactical and technical (technical) task by a scientific and technical council or conclusions of the main research institution of another state customer (The Procedure, 2021).

In addition, it should be emphasized that the development, commissioning and production of samples during a special period, a state of emergency and during a period of anti-terrorist operation is carried out in accordance with the Procedure for the supply of weapons, military and special equipment and ammunition during a special period, the state of emergency, measures to ensure national security and defense, repulsion and deterrence of armed aggression and during the period of the anti-terrorist operation, approved by the Resolution of the Cabinet of Ministers of Ukraine No. 345 of February 2015.

In general, the last mentioned Procedure should be characterized as a positive loosening of the state bureaucracy regarding a design, testing, fielding and production of weapons for the Armed Forces of Ukraine under the martial law (The Procedure, 2015).

Thus, martial law in Ukraine was introduced in connection with the opening of the full-scale invasion of the Russian terrorist troops, which began on February 24, 2022. A good liberal legislation was approved for designing, testing, arming and producing of the short-range ballistic missiles for the Armed Forces of Ukraine (up to 500 km).

Financial and legal challenges of ensuring design for production of short-range ballistic missiles in Ukraine in context of full-scale invasion of Ukraine by the russian-terrorist forces on February 24, 2023

Ukrainian ballistic missile designers and manufacturers need funding. The Ukrainian government is consciously losing to Russia in the technological militarization of weapons production. The Ukrainian government is counting on Western weapons. This is reasonable in the short term, but it is dangerous from a strategic point of view. After all, the political

environment is volatile. Lack of funding is a major problem for the design and production of Ukrainian ballistic missiles. After all, Ukrainian rocket scientists do have technologies for the production of ballistic missiles.

However, they are really significant for ballistic missile producers, regardless of their form of ownership. In this case, there is no need to count on state funding. All the funds allocated to the Ministry of Defense of Ukraine are used for the current financing of the Armed Forces of Ukraine and the purchase of weapons already in service and which have been tested during the war. At the same time, it should be noted that Ukrainian business entities developing the Ukrainian short-range ballistic missiles cannot attract domestic, let alone foreign investors to these projects without some appropriate government guarantees. The Ukrainian arms manufacturers also cannot have sufficient working capital in the absence of the ability to export technologies or their products (Krol, 2023).

Accordingly, in order to solve the challenge of securing financing for the Ukrainian business entities engaged in the design and production of short-range ballistic missiles for the Armed Forces of Ukraine, guarantees from the Government of Ukraine are required to obtain loans from commercial banks or attract investors against the state guarantees.

The positive factors in this area include introduction of scientists from a number of private institutions and private-owned business entities into the economic arena of designing and testing of the short-range ballistic missiles for the Armed Forces of Ukraine. This may significantly reduce the estimate of funds raised until a system with a short-range missile is adopted by the Ministry of Defense of Ukraine. For example, the Defense Express Information and Consulting Company highlights the point that the State Design Bureau still needs $500 million to complete the development, testing, and fielding of the Sapsan tactical missile system (Krol, 2023). In turn, the designers and management of the private design bureau "Science & Space" propose an estimate of $25 million for a similar product that will serve the same purpose (The Operational, 2023).

Conclusions

The Russian-Ukrainian war, in general, and the full-scale Russian-terrorist invasion that began on February 24, 2022, have clearly shown that political miscalculations in the space and missile industry lead to some severe outcomes. Thousands of civilians were killed and injured, and hundreds of critical infrastructure facilities were destroyed by the Russian terrorists, whose crimes were committed with Russian ballistic and cruise missiles.

The Ukrainian Armed Forces did not have and practically did not have ballistic and cruise missiles to deter the aggressor. Our Western partners are gradually and very reluctantly supplying new types of weapons to Ukraine. However, the Armed Forces of Ukraine are not authorized by the international community to use them on the territory of Russia. And the missiles of Russian terror are launched from there. Consequently, Ukrainian society cannot do without its own production of missiles to deter the Russian aggressor. To this end, the Verkhovna Rada and the Government of Ukraine have created good conditions for the start of design, testing, and adoption.

The situation with funding for development and testing of the Ukrainian short-range missile systems for the Armed Forces of Ukraine has become critical. The Ukrainian government has no budgetary funds available, investors are not coming to a war-torn Ukraine, and the Ukrainian volunteers are covering only the immediate needs of the Ukrainian army.

The authors propose to solve this challenge by providing guarantees by the Government of Ukraine to the Ukrainian business entities engaged in the design and production of short-range ballistic missiles for the Armed Forces of Ukraine under loans from commercial banks, or by attracting investors under the state guarantees in this way.

The article emphasizes a positive role of specialized scientific institutions and private entities engaged in design and testing of short-range missile systems for the Armed Forces of Ukraine. This brings a positive competition to this area and reduces the cost of developing and producing of the Ukrainian short-range ballistic missiles for the Armed Forces of Ukraine by an order of magnitude.

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Missile Weapons as an Instrument of Crime: Issues of Criminal Liability and Jurisdiction

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The article analyzes the system of national and international judicial and law enforcement bodies as subjects of criminal prosecution of Russian aggressors committing criminal acts in Ukraine using missiles. It is established that the Ukrainian subjects of criminal proceedings are local general courts, courts of appeal and the Supreme Court of Ukraine. From the point of view of international justice, it is proved that the Russian military personnel who are suspected of committing war crimes and crimes against humanity fall under the jurisdiction of the International Criminal Court. It is emphasized that the military and political leadership of Russia may be brought to criminal responsibility to a special international tribunal for unleashing and waging of an aggressive war, which could be created by the states of the anti-Putin coalition.

Keywords: ballistic missiles, security, missile weapons, crime, international criminal responsibility, criminal jurisdiction, the Russian-Ukrainian war, humanitarian law, International Criminal Court.

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Introduction

The democratic world community has clearly affirmed that human life and health are of the highest values and that the borders of sovereign states are irreversible. In the European arena, a decade after World War II, peoples began to forget about historical territories and claims to other states for them. The peoples of Europe began to unite for the sake of living together on the basis of common European values. To some extent, they have made some mistakes. One of the main one was the policy on relations with Russia.

After the collapse of the Soviet Union, the illusion arose that the Russian people were striving for democracy. Accordingly, the Western world helped the Russian government to keep the financial and economic situation under control during the early 1990s. This virtually saved the Russian Federation from disintegration. For a long time after Putin's regime came to power, the EU had failed to notice the curtailment and regression of democratic reforms, suppression of the opposition, and violations of citizens' rights and freedoms. Even Russia's armed aggression against Georgia in 2008, the annexation of Crimea and the outbreak of war in eastern Ukraine did not result in effective sanctions against Russia and its top military and political leadership.

It was only the full-scale invasion of Ukraine by russian-terrorist forces that began on February 24, 2022, which made the Western politicians act. It was already at a time when Russian missiles were bombarding Ukrainian lands, and the aggressor was moving in columns toward Kyiv, Kherson, Melitopol, Sumy, Kharkiv, and Chernihiv. From that moment on, the Russian military began committing crimes in Ukraine, using missiles as a weapon. Along with military targets, they began to hit civilian infrastructure, cultural and educational facilities, and civilian residences of Ukrainian citizens from the very beginning.

After a year and a half of full-scale invasion, they have already amassed tens of thousands of deaths and injuries, and significant damage to civilian infrastructure and private property.

Unfortunately, these facts, which have signs of war crimes and crimes against humanity, continue unabated. Accordingly, Ukrainian and international judicial and law enforcement agencies should record them and detain those suspected of committing them. They should also conduct preliminary investigations and bring them to a competent court for a fair trial. There are still many problems along the way.

At the beginning of the article, the authors gave a general description of the Russian missiles that are most harmful to the people of Ukraine. These are Russian ballistic and cruise missiles (Kinzhal, Iskander, Kalibr, Kh-101). The examples have illustrated certain aspects of the legal interpretation of tactics of their use. Subsequently, the authors analyze the capabilities of the national Ukrainian criminal jurisdiction in cases involving the use of missile weapons against civilian objects and the population of Ukraine. It is proved that, including in the context of martial law and warfare, the only subject of criminal proceedings against the Russian military who committed acts with the use of missiles bearing the signs of crimes include: the system of local general courts, courts of appeal and the Supreme Court of Ukraine.

At the end of the article, from the point of view of international criminal jurisdiction, it is concluded that the Russian military, suspected of committing war crimes and crimes against humanity by programming, preparing for the launch and launch of missiles, falls under the jurisdiction of the International Criminal Court for murder, maiming of Ukrainian citizens, destruction of civilian infrastructure and non-militarized property.

It is emphasized that the highest military and political leadership of Russia cannot practically be held criminally liable in the current system of international criminal prosecution for the unleashing and waging of an aggressive war. For this purpose, a special international tribunal should be established by the anti-Putin coalition. Or they can be brought before the national court of a new Russian regime or one of the independent states that will emerge after the collapse of the Russian Federation. After all, the current Russian criminal code provides for severe criminal liability for such acts.

Characteristics of missile weapons and consequences of their use in the russian-ukrainian war

The Russian hypersonic aircraft system Kh-47M2 “Kinzhal” with the ballistic missile of the same name has a warhead weighing 500-800 kg, which can hit targets at a distance of 2000 km from the booster (aircraft) with high accuracy at a speed of 4080 m/s. For a long time, Ukrainian air defense had not had any means of destroying such ballistic missiles. Now the situation is different. Officially, on May 4, 2023, the first instance of a Kinzhal missile being shot down was recorded and made public. However, the Kinzhal ballistic missile remains the most dangerous weapon for the citizens of Ukraine and the Armed Forces of Ukraine (Oleshchuk, 2023). The Iskander missile system has a line of missiles of the same name, which can accurately launch a 500-800 kg warhead at six speeds of sound at a distance of 500 km. For example, on May 28, 2022, the Russian occupiers launched a missile attack on the city of Merefa in the Kharkiv region, destroying a solar power plant. The missiles caused craters six meters deep and 11 meters in diameter. The power plant was completely disabled (Sakrevska, 2022).

The Kalibr missile belongs to a family of modern Russian cruise missiles. It is one of the most dangerous cruise missiles that can be launched from sea and airborne carriers. It has a 450 kg warhead that can hit targets at a distance of up to 300 km with high accuracy at twice the speed of sound. For example, on July 14, 2022, a missile hit a shopping district in the

regional center of Ukraine, Vinnytsia, killing 20 people and injuring 25. Not to mention the material damage: about 50 cars were burned, and the shopping center was also damaged (The shelling, 2022).

The Russian strategic air-to-ground cruise missile Kh-101. It delivers a warhead at a distance of up to 5000 meters with an accuracy of 10 meters. The weight of the warhead ranges from 400 to 960 kilograms. An example of its use, on April 23, 2022, a missile hit a residential building in the southern regional center of Ukraine, Odesa. Eight civilians were killed, including a three-month-old baby, and 18 people were injured (Shelling, 2022).

Thus, the Russian military has several modern ballistic and cruise missiles (Kinzhal, Iskander, Kalibr, Kh-101), which have the technical capability to be used exclusively against some military targets of the Armed Forces of Ukraine, as they are highly precise. However, in most cases, they are used to target residential buildings, civilian objects and civilian infrastructure. These facts have all the elements of war crimes and crimes against humanity.

According to the Office of the Prosecutor General of Ukraine, during the full-scale invasion of the Russian Federation (as of 3.07.2023), 96,26273 crimes were registered (violation of the laws and customs of war (Article 438 of the Criminal Code), planning, preparation or unleashing of an aggressive war (Article 437 of the Criminal Code), war propaganda (Article 436 of the Criminal Code), 17,072 crimes against national security (encroachment on the territorial integrity and inviolability of Ukraine (Article 110 of the Criminal Code), high treason (111 of the Criminal Code), collaboration (111-1), aiding the aggressor state (111-2 of the Criminal Code), sabotage (Article 113 of the Criminal Code). In particular, the deaths of 494 children and 1036 injuries were verified. This is without fully taking into account of information from the temporarily occupied territories and places of active hostilities (Crimes, 2023).

According to the Command of the Armed Forces, the Russian military is constantly attacking residential areas of Ukrainian citizens and civilian infrastructure with rockets. As a result, civilians are being killed and injured. Such actions of the Russian military and political leadership and the military directly involved in planning, programming, preparation and launching of missiles have signs of crimes of aggression and war crimes. Here are some facts of the actions that have signs of such crimes only in the first half of 2023: on January 14, 2023, a Russian missile (most likely it was the Kh101) hit a residential high-rise building in Dnipro, killing 45 people, including five children. Five more children were left as orphaned. Relatives are taking custody of three of them. Two children were placed in state care because they had no relatives to care for them. In total, 487 victims lodged statements with the police. Twenty-eight people were sent to hospital with injuries of varying degrees, 10 of them were in serious condition (Hamaliy, 2023); on April 28, 2023, the Russian terrorists launched a missile attack on a building in Uman, located in the Cherkasy region of Ukraine. The missile hit the high-rise building, killing 23 people, including 6 children (Borsukova, 2023); in early June 2023, the Russian terrorists fired more than a hundred attack drones, cruise missiles, and Iskander ballistic missiles at the Ukrainian capital Kyiv. They hit four people, including a 9-year-old child (Kovtsun, 2023); on June 14, 2023, Odesa was hit by four Kalibr missiles from a Russian ship in the Black Sea. Three civilians were killed, and seven were injured, and a business center, an educational institution, a residential complex, catering establishments, and shops were damaged (Yakymiuk, 2023); on the night of June 13, 2023, Russian terrorists launched another massive missile attack at Ukraine, firing 15 cruise missiles. This time, the city of Kryvyi Rih came under a powerful attack, where the enemy launched six missiles. Three of them were shot down by air defense, but the rest hit the civilian objects. In particular, a five-story residential

building was hit. Ten people were killed. About 30 people were wounded. Three of them were in serious condition in the hospital. One of them had 100% of his skin affected, the other – 80% (Russia, 2023).

This is despite the fact that the Russian military cannot help but know that under international humanitarian law, an attack on a civilian object, such as a residential building, is a serious violation of human rights and is prohibited under Annex I to the Geneva Conventions of 1949. The responsibility for such actions lies solemly on the Russian state, which is responsible for shelling civilian objects in Ukraine.

The common features of these acts of the Russian military are as follows: civilians are killed and injured, civilian infrastructure is destroyed; means of remote long-range strike are used – short- and medium-range missiles; missiles as means of striking can be divided into two categories: first, indiscriminate actions that by the very fact of use have signs of crime, because it is impossible to use them accurately on military objects without the likelihood of hitting civilians; secondly, the precision missiles that are specifically used on civilian objects.

National criminal jurisdiction over the use of missile weapons against civilian objects and population

The system of national and international bodies having the competence to investigate and prosecute crimes of aggression and war crimes involving Russian missiles includes the system of law enforcement and judicial bodies of Ukraine, the European and international community. In Ukraine, these are the Security Service of Ukraine, the prosecutor who oversees the observance of laws during the pre-trial investigation in the form of procedural guidance of the pre-trial investigation, and the courts of general jurisdiction conducting criminal proceedings.

In accordance with the competence granted by the Criminal Procedure Code, the security investigative bodies carry out pre-trial investigations of criminal offenses under Article 438, "Violation of the Laws and Customs of War" (Criminal, 2001). The relevant Law as of March 25, 1992, No. 2229-XII defines the Security Service of Ukraine as the special purpose state body with law enforcement functions ensuring the state security of Ukraine.

Its competencies include the protection of state sovereignty, constitutional order, territorial integrity, scientific, technical and defense potential of Ukraine, legitimate interests of the state and citizens' rights against intelligence and subversive activities of foreign special services, attacks by individual organizations, groups and individuals, as well as ensuring the protection of state secrets. At the same time, supervision over the observance of laws by the units of the Security Service of Ukraine that carry out operational and investigative activities, inquiries, pre-trial investigations, as well as execution of court decisions in criminal cases and application of other coercive measures related to the restriction of personal freedom of citizens, is carried out by the prosecutor (On the Security, 1992).

For example, based on SBU materials, prosecutor Person1 was sentenced to life imprisonment for "betraying" the positioning of the Armed Forces of Ukraine in the Mykolaiv region to the enemy. Based on the evidence collected by the SBU, the former head of the Mykolaiv District Prosecutor's Office was sentenced to life imprisonment. Following a public prosecution by prosecutors of the Specialized Prosecutor's Office in the Military and Defense Sphere of the Southern Region, he was found guilty of high-level treason (Part 2 of Article 111 of the Criminal Code of Ukraine). According to the investigation, the former head of the Mykolaiv District Prosecutor's Office collaborated with representatives of the Russian Federation's se-

curity forces. Having done this, he used an intermediary to "cover his tracks." According to the gathered data, he transmitted information about: an operational situation in Mykolaiv and the region; killed military and civilians, prisoners, places of their detention; the results of the shelling of Mykolaiv; daily passwords to checkpoints in the region, etc. The court has now sentenced him to life imprisonment with confiscation of property (The SBU, 2023). It was through the fault of such individuals that dozens of marines got killed in Mykolaiv when a Russian S300 missile accurately hit one of the barracks where Ukrainian soldiers had been stationed on April 18, 2022 (Miroshnychenko, 2023).

This is one of the rare cases when the authors do not express any claims against the Russian military from the point of view of international humanitarian law, despite the tragedy for the families of the victims, to whom we express our sincere condolences. After all, from the point of view of formal dogma, the combatants of one side of the war killed the combatants of the other. That is why, in our opinion, the judges of the Prymorskyi District Court of Odesa correctly qualified the crime of Person 1 as treason, not complicity in committing a terrorist act or violation of the laws and customs of war.

The prosecutor, while supervising the observance of laws during the pre-trial investigation in the form of procedural guidance of the pre-trial investigation, is authorized to: initiate a pre-trial investigation if there are grounds provided for by the CPC; have full access to materials, documents and other information related to the pre-trial investigation; instruct the pre-trial investigation body to conduct a pre-trial investigation; instruct the investigator, pre-trial investigation body to conduct investigative (detective) actions within the time limit established by the prosecutor, covert investigative (detective) actions, other procedural actions or to provide instructions on their conduct or participate in them, and, where it is necessary, to personally conduct investigative (detective) and procedural actions; to entrust investigative (detective) actions and covert investigative (detective) actions to the relevant operational units; to cancel illegal and unjustified decisions of investigators (Criminal, 2001).

According to the Constitution, justice in Ukraine is administered exclusively by courts. Delegation of the functions of the courts, as well as the appropriation of these functions by other bodies or officials, is forbidden. The jurisdiction of the courts extends to any legal dispute and any criminal charge. In cases provided for by law, courts also hear other cases. Extraordinary and special courts may not be established (The Constitution, 1996). The courts specialize in civil, criminal, commercial, administrative, and administrative offense cases. In local general courts and courts of appeal, there is a judicial specialization in criminal proceedings against minors (On the Judicial, 2016).

There are no military tribunals or special courts for war criminals and there should not be any. This would not only contradict the Constitution of Ukraine but is also impractical. After all, despite the existing problems in the Ukrainian judiciary, the courts in the area we are analyzing are effective. For example, the Security Service of Ukraine gathered indisputable evidence of the guilt of another Russian military officer who had participated in the shelling of Ukrainian cities. The offender is the deputy commander of a military unit of the 6th Air Force and Air Defense Army of the Western Military District of the Russian Armed Forces. On March 6, 2022, he crossed the state border of Ukraine on a Russian combat aircraft and bombed a radio and television station in Kharkiv. It was established that the enemy used eight FAB-500 aircraft bombs with a total weight of 2.5 tons of TNT equivalent to conduct the air attack. The pilot himself was shot down by the Ukrainian defenders immediately after he had dropped the bombs. He was detained after ejecting and landing. Based on the evidence

collected by SBU investigators, the court found him guilty under Part 2 of Article 28 and Part 1 of Article 438 of the Criminal Code of Ukraine (violation of the laws and customs of war). The defendant was sentenced to 12 years in prison (SBU, 2023).

Unfortunately, to date, it has not yet been possible to bring to criminal responsibility the Russian military who program, prepare for launch and launch missiles that hit civilian objects in Ukraine, killing civilians. However, it is only a matter of time. All their criminal actions are being recorded. Many of them have already been identified by the SBU and in the course of journalistic investigations. After victory of the Ukrainian people, those of them who remain alive will not escape criminal liability.

For example, the investigative journalists from The Insider, Bellingcat, and Der Spiegel managed to find out who was guiding these missiles at civilian targets. It is a secret unit within the Main Computing Center of the Russian Armed Forces that determines flight missions for precision-guided missiles. Investigators, by detailing calls comparable to the shelling of Ukraine, identified 30 Russian military engineers, most of them young men and women with a background in information technology and even computer game development. The journalists established the names and positions of these war criminals. We managed to find out that all the rocket scientists currently serving at the main computer center are registered as living and working at 19 Znamenka Street in Moscow, the official address of the General Headquaters of the Russian Armed Forces. The functions of the Main Computer Center are described in military publications as "providing IT services" and "automation of the Russian Armed Forces." Investigators discovered that its employees include not only military personnel, but also people with civilian experience as corporate IT specialists or even game designers (Robeyko, 2022).

Thus, even under martial law and hostilities, the only judicial authority in Ukraine is the courts of the general jurisdiction. This fully applies to the criminal proceedings, which are exclusively conducted in local general courts, courts of appeal and the Supreme Court.

Peculiarities of International Criminal Jurisdiction in cases where missile weapons were used against civilian objects and populations in Ukraine

The most legitimate way to bring the Russian military and the top political leadership of the Russian Federation, who are suspected of starting and waging an aggressive war, to justice through the UN. The primary of the latter is the International Court of Justice, which resolves disputes of a legal nature that are referred to it by the states in accordance with international law. An international legal dispute can be defined as a disagreement on a question of law or fact, a conflict or clash of legal views or interests. A court can only consider a dispute when the states concerned recognize its jurisdiction. Therefore, no state can be a party to proceedings before the Court unless it has in one way or another consented to it (Sakrevska, 2022).

However, it should be emphasized that as long as Russia remains a permanent member of the UN National Security Council, there is no question of any prosecution of the Russian Federation as a state and its top military and political leadership in the UN structures or under the UN umbrella. Today, a significant part of the world's diplomatic corps and international organizations is fighting to deprive Russia of the "seat" in the UN National Security Council, which it is illegally occupying. In Ukraine, the initiative group to expel the Russian Federation from the UN has made significant progress in a short period of time, conducting research, an information campaign and negotiations with experts in international law and relations and

organizations around the world, convincing them of the need to take some effective steps to restore justice within the UN and introducing a petition in support of the idea of expelling Russia from the UN (Yelchenko & Baryshnikov, 2022). However, in our opinion, it is not possible to resolve this issue in the nearest years. Accordingly, it is necessary to use other tools of international justice.

Therefore, Ukraine has entered into cooperation with the International Criminal Court (ICC) to investigate crimes that have been committed on its territory since 2014, which is appropriate. In this regard, it is important to study the legal status and jurisdiction of the ICC. The ICC's jurisdiction extends to Ukraine in accordance with the Statement of the Verkhovna Rada of Ukraine applied with the International Criminal Court on Ukraine's recognition of the ICC's jurisdiction over the crimes against humanity. According to Article 7 of the Rome Statute, the crimes against humanity are those committed as part of widespread and systematic attacks against the civilian population, which are committed in a deliberate way. Crimes against humanity, unlike war crimes, do not require the existence of an armed conflict, although they can occur during such conflicts. Article 7 of the Rome Statute contains an exhaustive list of acts that are considered as the crimes against humanity (Rome, 1998).

At the Munich Security Conference, held on February 17-19, 2023, US Vice President Kamala Harris addressed the crimes against humanity committed by Russia in Ukraine. British Prime Minister Rishi Sunak called for increased military support for Ukraine, and NATO Secretary General Jens Stoltenberg called Putin's victory the greatest risk to the world order. In her speech at the conference, Kamala Harris noted that there was evidence of executions, rape, torture, and forced deportations taking place in Ukraine, including of Ukrainian children (Munich, 2023).

In general, it should be noted that the International Criminal Court in the Hague can hold Russia's top leadership accountable for three types of violations of international law: war crimes, crimes against humanity, and genocide. The deportation of children, for which an arrest warrant was issued to Russian President Vladimir Putin, falls under the first point. At the same time, the ICC cannot convict for the crime of aggression – which is the fact of Russia's attack on Ukraine. Neither Ukraine nor Russia has ratified the court's founding document, the Rome Statute. In order to convict Russia and Putin for the attack, a special tribunal must be established (Bagmatiuk, 2022).

Clear examples of crimes against humanity committed by the Russian aggressors occurred in Bucha and Irpin. According to official data, Bucha and the Bucha district had been occupied by Russian troops for 33 days. According to confirmed reports, there were over 1400 deaths, including 37 children. More than 175 people were found in mass graves and torture chambers. Nine thousand cases of war crimes by the Russian military were registered. However, there is more to it, the city was liberated more than a year ago and became a symbol of the cruelty and inhumanity of the Russian invaders (More, 2023).

In the world of events, on June 6, 2023, at about 2:50 am, a war crime, an act of ecocide, was committed by the Russian invaders. The destruction of the dam of the Kakhovka hydroelectric power plant (Kakhovka disaster), about 16,000 people, and 80 settlements that could be flooded were in the area of the terrorist attack (Kakhovka, 2023). Another example is when Russian aircraft dropped a high-powered bomb on a drama theater on March 6, 2022. Satellite images show that there were signs in front of and behind the drama theater in Mariupol that read "Children" for airplane pilots to see, but this did not stop the killers. According to various official reports, the number of dead varies from 300 to 600 people who were hiding there from

the shelling (Mazur, 2023).

Today, Russian terrorists continue shelling Ukrainian cities. In this context, it is important to take into account the norms of international humanitarian law governing armed conflicts in order to ensure safety of civilians, use protective mechanisms that guarantee an appropriate response to crimes against humanity, and effectively bring the perpetrators to justice in accordance with national and international law.

Thus, it is impossible to ignore such a working body for the international prosecution of Russian terrorists as the International Center for the Prosecution of Criminal Aggression against Ukraine (ICPA). The ICPA is a unique judicial center integrated into Eurojust to facilitate national investigations of criminal aggression relating to the war in Ukraine. Through the ICPA, independent prosecutors from different countries will be able to cooperate in a single location on a daily basis, exchange evidence quickly and efficiently, and agree on a joint investigation and prosecution strategy. The ICPA will facilitate the efficient preparation of cases and will participate in any future prosecution of the crime of aggression, regardless of the jurisdiction in which the cases are filed.

ICPA participants will receive individualized operational, technical, logistical and financial support from Eurojust. The Core International Crimes Evidence Database (CICED), managed by Eurojust, will play a key role in supporting the ICPA. Evidence that has already been submitted to the CICED database in the context of other international crimes (crimes of genocide, crimes against humanity and war crimes) may be relevant to the investigation of the crime of aggression. The CICED will also be able to store national evidence provided by future ICPA participants for further analysis. The location of the Center in the Hague has several advantages. Not only will the ICPA have direct access to the valuable materials of the Genocide Network Secretariat stored at Eurojust, but it will also be able to cooperate closely and interact with the ICC and other international justice actors. Besides Ukraine, the five members of the Joint Investigation Team (JIT) (Lithuania, Latvia, Estonia, Poland, and Romania) are participating in the initial phase of the ICPA. After signing a Memorandum of Understanding with the JIT members, the United States appointed a special prosecutor for the crime of aggression to facilitate the ICPA's activities (The International, 2023).

It is also an urgent issue not only to bring perpetrators to justice for the crimes committed with missile weapons against civilians, but also to compensate victims, including compensation for physical and mental suffering, loss of property, and support in recovering from the tragedy. In cases where the perpetrators are state actors, human rights violations can be addressed at the international level, depending on the context and possible sanctions. The international community should respond to such violations of armed conflict and take appropriate measures to ensure peace and security. This may include diplomatic pressure, sanctions, international commissions of inquiry, or referrals to the International Criminal Court to address war crimes and violations of international humanitarian law.

Thus, Russian terrorists suspected of committing war crimes and crimes against humanity by making decisions (the highest military and political leadership of Russia) on programming, preparing for the launch and launch of missiles fall under the jurisdiction of the International Criminal Court for mass murder, maiming Ukrainian citizens, and destroying civilian infrastructure and private property.

As for bringing the military and political leadership of Russia to criminal responsibility for planning, preparing or unleashing an aggressive war, they may be held liable for these acts that have signs of a crime in accordance with the norms of the Ukrainian and, surprisingly, the

Russian criminal code, since the latter contains such article. It is clear that the latter will be possible to implement only after the change of political regime in Russia or in the independent republics that will emerge from the destruction of the Russian Empire. Also, we do not reject the possibility of establishing a special international tribunal for the Russian military and political leadership suspected of committing war crimes, crimes against humanity, and genocide against the Ukrainian people, as well as launching and waging an aggressive war.

Conclusions

Thus, bringing to criminal responsibility the Russian military and its political leadership, representatives of the Russian armed forces who program, prepare, launch and control missiles that kill the 0Ukrainian civilians and destroy civilian infrastructure is a complicated military and jurisdictional issue. The first thing to do is to defeat the Russian aggressor – to drive it beyond the state borders of Ukraine, which are recognized by the international community.

At the same time, for the sake of future generations, it is necessary to record events that have signs of crimes committed by Russian military terrorists and Ukrainian female collaborators. It is concluded that the Ukrainian law enforcement system and courts effectively and fairly prosecute persons detained for war crimes. However, the main work is still ahead, as more than ninety thousand criminal proceedings on this topic have already been registered. It has been proven that the Russian military, who program, prepare for launch and launch missiles, they cannot help to know that they are flying at civilian objects. After all, modern Russian missiles are accurate, which virtually eliminates cases of deliberate killing of Ukrainian civilians.

The Russian military and political leadership, as well as those who programmed, prepared for launch, launched, and accompanied the missiles, have the opportunity to suffer a fair criminal punishment by a court decision presented to them by the anti-Putin coalition in one of the following ways: the national Ukrainian courts; the national Russian courts under a new Russian regime or in one of the independent new states after the collapse of Russia; in the International Criminal Court or an international tribunal specially created for this purpose.

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Enhancing Space Law for Ensuring Global Space Security in an Era of Growing Space Threats

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This article delves into the imperativeness of addressing space threats and safeguarding global space security, elucidating actionable measures to mitigate risks and safeguard the interests of humanity. The paper explores the evolving landscape of space threats, including the increase in space activities, the accumulation of space debris, challenges in space traffic management, and the preservation of dark skies. It highlights the need for enhanced space law to serve as an effective legal instrument and examines the interpretation of "peaceful" in the context of space activities. The role of space security and its interplay with global security is also discussed, emphasizing the protection of assets, activities, and interests in space.

Keywords: space security, weaponization, space race, militarization and deterrence, space activities, Space Code.

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Introduction

In a world plagued by devastating invasions and nuclear threats, preventing conflicts in space activities is crucial. The current international legal framework and regulatory systems were established in a different geopolitical context, leading to confusion, inconsistencies, and violations. The absence of a unified international organization capable of managing space risks complicates the situation. This article emphasizes the urgency of addressing space threats and proposes measures to mitigate risks and safeguard global space security. The absence of any previous space wars poses a significant challenge, as governments possess limited experience upon which to draw when attempting to anticipate the actions that might incite a potential adversary to engage in hostile acts. Moreover, the velocity and trajectory by which such actions could escalate into a full-fledged conflict further complicate this issue (Maxwell & Wilson, 2021).

In an era marked by grave ramifications of invasions, wars, and nuclear peril, redirecting our focus toward preventing conflicts in the sphere of space activities becomes paramount. The proliferation of space actors and emerging technologies, coupled with the anticipated exponential increase in orbital objects and space security concerns, necessitates a comprehensive reassessment of the existing international legal framework and regulatory systems. The prevailing geopolitical context, significantly different from when these mechanisms were initially established, has led to confusion, inconsistencies, and violations pertaining to natural mechanisms, space security, and human rights. Furthermore, the absence of an international organization vested with full authority to manage risks and threats to space assets further complicates the scenario. Against the backdrop of an increasingly deteriorating geopolitical environment, collaborative control over orbital resources emerges as an urgent necessity, underscoring the cruciality of enhancing space law as an effective tool for ensuring space security in the future.

The evolving landscape of space threats

Historically, economic, and military competitiveness go hand in hand, but humanity cannot afford to follow the same pattern in space (Townsend, 2021). Currently, there is a noticeable rise in the quantity of both public and private entities involved in space activities. This expansion is accompanied by the emergence of novel space technologies and markets. Consequently, one can anticipate a proportional increase in the number of objects present in orbit, as well as a corresponding surge in space security concerns. These concerns include the escalating accumulation of space debris, challenges associated with space traffic management, and the issue of dark sky preservation, among others. It is worth noting that the existing international legal and regulatory framework was formulated within a distinct geopolitical context, wherein only two spacecraft were operational in Earth's orbit. In stark contrast, the present reality entails the presence of over 20,000 space objects currently orbiting our planet. Projections suggest that this figure will escalate to approximately 38,000 spacecraft within the next decade (Pivovarov, 2021). The proliferation of numerous satellites will impose a substantial burden on the already strained technical capacities of terrestrial infrastructures. This surge in space objects and vehicles, coupled with the prevailing international legal and regulatory framework, gives rise to legal ambiguities and inconsistencies, and compromises the integrity of natural mechanisms, space security, and human rights. The understanding of risk has evolved beyond the concept of a physical adversary that can be combated with weaponry, to a persistent sense of vulnerability that permeates the daily lives of individuals. This multifaceted scenario is marked by novel challenges, including an upsurge in crises of various types, their unpredictable nature, and their global extent. Additionally, the escalation of military conflicts has further amplified these threats (Fiumara, 2015).

Simultaneously, the absence of a comprehensive international organization with the authority to effectively manage risks and threats to space assets presents a significant challenge. The establishment of international governance systems for outer space encounters complexities arising from bureaucratic structures and political legacies. While it is crucial to make progress in adopting multilateral approaches to space security, the barriers extend beyond conflicting public interests to encompass competing interests that may prove difficult to overcome. Furthermore, the contemporary landscape is characterized by a growing number of global predicaments, including deglobalization, the conflict in Ukraine, supply chain

disruptions, the global energy crisis, and a prolonged decline in foreign direct investment. These factors further complicate the situation surrounding the management of space risks and threats (Kornprobst & Paul, 2015).

Hence, the repercussions of such circumstances may result in a diminished impact of international programs, specifically those pertaining to space security and safety on a global scale. Presently, these programs encompass the domains of space situational awareness and space weapons concepts. This escalation amplifies the proliferation of space-related threats and holds the potential for catastrophic consequences. This concern was similarly raised and acknowledged during the 76th Session of the United Nations General Assembly in 2021. In his address to the Assembly, the United Nations Secretary-General issued a fervent call to the international community, urging them to awaken to the gravity of the situation. He emphasized that humanity teeters on the precipice, traversing a path that leads in the wrong direction. He further underscored that our world has never faced greater peril, confronting a formidable array of crises unparalleled in our lifetimes (European, 2021).

One year following Russia's invasion of Ukraine, the situation experienced a substantial deterioration, giving rise to new and emerging threats. These threats encompass the unanticipated exploitation of data by external entities, the susceptibility of space infrastructure to malicious activities and orbital hazards, as well as a concentrated and delicate global supply chain reliant on a limited number of major stakeholders and intricately specialized components. The present geopolitical landscape raises apprehensions regarding the feasibility of international space cooperation precisely when collaborative management of orbital resources is crucially needed[1]. In order to guarantee space security in the forthcoming era, it is imperative to enhance space law, enabling it to serve as an effective legal instrument.

The role of enhanced space law

In contemporary times, it has become imperative to embrace a methodical and all-encompassing strategy in tackling the predicament of space threats. To illustrate, Astrium UK, a division of the France-headquartered enterprise Astrium, is currently engrossed in the advancement of harpoon technology with the purpose of eradicating defunct satellites from the vast expanse of outer space (Reed & Barraclough, 2013). However, based on its inherent characteristics, such a harpoon possesses the potential to facilitate space traffic, while simultaneously raising concerns regarding its high firing speed, which could classify it as a weapon. It is worth noting that international law explicitly prohibits the utilization of space weapons, although the implementation of effective regulations for space traffic management remains elusive. An additional cause for apprehension revolves around the existence of nuclear power plants aboard certain spacecraft. These power plants are specifically engineered to separate the enriched uranium block and subsequently place it in a distant orbit during re-entry. Unfortunately, instances of failure have been documented, leading to the contamination of debris that subsequently plummets Earth. Even the presence of a solitary fragment with an unpredictable flight trajectory can pose substantial risks within orbital space. Presently, one of the most critical threats we face is the potential transformation of space into a theater for

[1] Space security is a critical issue for the United Nations, with references to it in the General Assembly's First Committee (Disarmament and International Security Committee) and Fourth Committee (Special Political and Decolonization Committee). At the Committee on the Peaceful Uses of Outer Space (COPUOS), especially in the Scientific and Technical Subcommittee and the Legal Subcommittee, today this is the main topic of conversation.

armed conflicts, a development that would render space infrastructure vulnerable and inflict catastrophic effects on the entirety of the planet. Inadvertent threats encompass a range of issues, including space debris, collision risks, and radio frequency interference. Conversely, intentional threats primarily manifest as the weaponization and militarization of space. The proliferation of anti-satellite weapons, conventional kinetic-energy weapons, laser weapons, jamming techniques, and cyber threats serves as evidence of the deliberate utilization of space for weapon development. In 1961, the American lawyer F. Schick made a significant observation, stating that attempts to reach a consensus on the timely implementation of a comprehensive space code incorporating effective international control measures would inevitably fail due to the prevailing realities of the space domain (Schick, 1961). These realities stem from the fact that continued technological advancements will exacerbate the complexities involved in resolving security concerns. Regrettably, there is a measure of truth in this statement. The expansion of the space industry presents formidable challenges to the establishment of a unified "Space Code." The rapid progression of ongoing processes obstructs the formulation of enduring and restrictive regulations (Soroka, 2020). Consequently, there is a pressing need for legal frameworks that are more responsive and adaptable to these evolving circumstances.

In his book, Max M. Mutschler emphasizes that the Outer Space Treaty (OST) serves as the primary legal framework governing the utilization of outer space (Mutschler, 2015). The treaty is founded upon the fundamental principle that the concept of national appropriation by sovereignty claims should not apply to outer space (Article II). Furthermore, it asserts that the exploration and utilization of outer space are a collective responsibility shared by all of humanity (Article I). While the preamble of the OST advocates for the peaceful utilization of space, it does not explicitly define the term "peaceful." However, it is widely understood that the parties to the treaty interpreted "peaceful" in line with the original perspective of the United States, which denotes a state of non-aggression.

Additionally, Article III of the OST imposes an obligation on parties to conduct their space activities in accordance with international law, including the provisions of the United Nations Charter. Consequently, a more comprehensive examination of the United Nations Charter is required to ascertain the precise definition of "peaceful purpose." Article 2(4) of the United Nations Charter establishes a general prohibition on the use of force by states. Nevertheless, Article 51 of the United Nations Charter explicitly recognizes the inherent right of self-defense. This recognition, as highlighted by the author, allows for an interpretation of "peaceful" as "nonaggressive" and implicitly legitimizes military applications of space, such as reconnaissance, under the pretext of self-defense (Mutschler, 2015).

Within the domain of space activities, the terminology employed, namely "peaceful" and "nonaggressive," often conveys a comparable notion, thereby enabling their interchangeable use. These terms signify the absence of hostile or aggressive behaviors in the pursuit of outer space exploration and utilization.

The interpretation of "peaceful" in the context of space activities aligns with the original perspective of the United States, which perceives it as synonymous with "nonaggressive." Thus, it follows that space activities should eschew acts of aggression and the application of force against other nations or their spatial assets. Instead, the focus ought to be on cultivating cooperation, collaboration, and the peaceful attainment of scientific, commercial, and exploratory objectives.

It is worth acknowledging that the precise explication of "peaceful" in the realm of space activities may diverge across nations. However, the connotation of "peaceful" underscores distinct aspirations and remains distinct from the notion of "nonaggressive." In the context of space activity, "peaceful" denotes that space exploration, research, and utilization should transpire in a manner that precludes the utilization of force, the engagement in military aggression, or any endeavors that may engender the militarization of outer space. This interpretation accentuates the promotion of cooperation, collaboration, and the constructive dividends derived from space exploration, such as advancements in scientific knowledge, technological innovation, and international amity.

Kai-Uwe Schrogl (Schrogl, 2005; Mutschler, 2015) suggests that the agreement governing the use of space does not explicitly prohibit the placement of conventional armaments in space. According to his interpretation, the development of conventional armaments in space may be considered legal as long as it does not involve aggressive actions and is solely intended for self-defense. However, this viewpoint presents an inherent contradiction, as self-defense cannot be regarded as "peaceful" in its nature. Furthermore, the explicit prohibition of weapon use in space renders the necessity of self-defense unnecessary, raising doubts about the validity of this interpretation.

In contrast, Detlev Wolter (Detlev, 2006) argues against the notion that the United States and the Soviet Union intended to legalize the placement of space weapons. Instead, these superpowers aimed to ensure that space activities served the collective interests of humanity, aligning with disarmament efforts and the avoidance of an arms race in space. Soviet scientists maintain that the United States and its military partners continue to pursue the utilization of space technology for military purposes. The US military space program includes the development of early warning and interception systems for satellites and ballistic missiles, the construction of military reconnaissance and radio navigation satellites, a series of communication satellites, the advancement of manned hypersonic spacecraft, orbital space stations, and exploration of the feasibility of creating orbital belts of artificial meteorites (referred to as space "minefields") and "asteroid bombs" (Zhukov & Kolosov, 2014).

Despite initial concerns about a potential space war, Andrew F. Krepinewich notes that the major powers, the United States, and the Soviet Union, managed to avoid an arms race in orbit. Instead, their competition shifted towards prestige, with manned and scientific achievements in space serving as indicators of national power. Although there was a moment when an arms race seemed possible, the intensity of the competition diminished after the successful US moon landing. However, during President Reagan's administration, the United States pursued an aggressive missile defense program that included a space component, which directly violated the Anti-Ballistic Missile Defense Treaty. This space component had the potential to ignite a new arms race in space as the Soviet Union sought to match or counter the United States' new capabilities. Nonetheless, the long-term costs of military competition, economic inefficiency, and a loss of faith in the capabilities of the Soviet forces eventually prompted the Soviet authorities to seek a peaceful solution (Krepinewich, 2015). Hence, it is imperative to promulgate well-defined regulations and precise delineations concerning these matters, particularly in relation to the terms "peaceful" and "nonaggressive" within the context of space activity. The establishment of unambiguous guidelines serves to minimize the likelihood of misunderstandings and mitigate the potential negative ramifications that may arise in this domain. By providing explicit definitions and clarifying the scope of these terms, the international community can foster a shared understanding and facilitate the

implementation of measures that promote the peaceful utilization of outer space, thereby ensuring the preservation of stability and the prevention of adverse outcomes.

Space security and its interplay with global security

The term "space security" refers to the protection and preservation of assets, activities, and interests in the space domain. It encompasses the measures taken to ensure the safety, sustainability, and peaceful use of space for all nations and stakeholders involved. Space security involves safeguarding satellites, spacecraft, space infrastructure, and other assets from potential threats, both natural and man-made. It also includes addressing challenges such as space debris mitigation, orbital congestion, cybersecurity, and the prevention of the weaponization of space. Space security is not limited to the protection of physical assets alone but also encompasses the broader aspects of security in the space domain. This includes ensuring the integrity and availability of space-based services such as communication, navigation, weather monitoring, and remote sensing, which are vital for various sectors of society, including telecommunications, transportation, emergency response, and scientific research.

The concept of space security is closely intertwined with global security, as the increasing reliance on space-based systems and technologies has made space an integral component of many aspects of modern life and national security. Disruptions or threats to space systems can have significant implications for a nation's security, economic well-being, and overall stability.

Considering the aforementioned context, a profound consideration of potential courses of action becomes imperative at this critical juncture. Central to this endeavor is a comprehensive examination of the concept of "space security," aiming to broaden its scope and understanding. Over time, the notion of "space security" has undergone a significant evolution, transitioning from a simplistic two-dimensional model to a more intricate three-dimensional framework.

Initially, space security was primarily defined in the context of the military balance between the United States and the Soviet Union during the Cold War. However, with the conclusion of the Cold War, a more comprehensive two-dimensional model emerged, encompassing both military and environmental aspects of space security. Presently, this two-dimensional approach is progressively giving way to a three-sector understanding that discerns various applications of space for security and defense. This paradigm recognizes three distinct sectors: the protection of assets in space against both natural and man-made threats, and the defense against threats originating from space itself (Sheehan, 2015).

Originally conceptualized as a two-dimensional model, the evolving nature of the "space security" concept necessitates a deeper exploration, particularly concerning the intricate interplay between space security and global security. In the contemporary era, the increasingly evident interdependence of global security and space security demands comprehensive exploration and analysis.

By delving into the multifaceted dimensions of space security, it becomes possible to formulate robust strategies that address the complexities of safeguarding assets in space, ensuring resilience against diverse threats, both terrestrial and extraterrestrial. Moreover, acknowledging the interconnection between space security and global security allows for the development of cohesive frameworks that promote international cooperation, transparency, and mutual understanding among nations, while mitigating potential conflicts and negative consequences in the space domain.

In conclusion, the quest for space security must be viewed holistically, integrating the evolving understanding of this concept with the broader context of global security. Emphasizing a multidimensional approach enables policymakers and stakeholders to navigate the intricate challenges and opportunities presented by space activities, promoting a safer and more stable space environment for the benefit of all humanity.

Mitigating risks and protecting human interests

Mitigating risks and protecting human interests in space activity is a paramount undertaking in ensuring the safety, sustainability, and responsible utilization of outer space. The pursuit of space exploration and exploitation brings forth a multitude of advantages and prospects, yet it also presents inherent risks and challenges that necessitate attention. One of the principal concerns in space activity revolves around the mitigation of risks associated with space debris. The accumulation of non-functional satellites, spent rocket stages, and other fragments poses a substantial hazard to operational spacecraft and the long-term viability of space endeavors. Endeavors are being made to track and document space debris, develop technologies for its removal, and establish best practices for satellite design to minimize the generation of such debris. Another critical facet of risk mitigation entails ensuring the safety of astronauts and space travelers. Human spaceflight entails inherent perils, including exposure to microgravity, radiation, and physiological stress. Robust safety protocols, advanced life support systems, and rigorous training programs are implemented to minimize risks and safeguard the well-being of astronauts during space missions.

In addition to technical risks, space activities also give rise to legal and ethical concerns. The protection of intellectual property, prevention of unauthorized access to space systems, and safeguarding of sensitive information are vital to uphold human interests in space. International agreements, such as the Outer Space Treaty and the Moon Agreement, provide a legal framework for governing space activities and ensuring the responsible conduct of states and organizations.

Furthermore, the safeguarding of human interests in space encompasses the assurance of equitable access to space resources and opportunities for all nations and stakeholders. The exploration and utilization of celestial bodies, such as the Moon and asteroids, should be conducted in a manner that fosters cooperation, fairness, and the collective benefit of humanity. International collaboration and the establishment of transparent and inclusive frameworks are essential to prevent the exploitation or monopolization of space resources. Ultimately, the endeavor to mitigate risks and protect human interests in space activity necessitates a multidimensional approach that encompasses technological advancements, international collaboration, robust legal frameworks, and ethical considerations. By addressing these challenges, we can forge a safer and more sustainable space environment that facilitates the exploration, scientific discovery, and commercial utilization of space for the benefit of present and future generations.

Moreover, it is essential to enhance the protection of human rights in space activities while considering the principles of “common genesis.” Space threats in outer space may have an impact on the realization of human rights, including the right to access space and the information obtained there, the right to benefit from scientific progress and its applications (Experts, 2009), the right to privacy (Regulation, 2016), the right relating to life and the environment in the context of ecocide (Boyd, 2012), the rights relating to humanitarian law,

and military conflict. The "development of weapons technologies endangers the enjoyment of human rights worldwide" (Experts, 2009), and the weaponization of space is no different. In particular, the militarization and weaponization of space raise concerns for specific rights, such as the right to life, the right to a safe environment, the right to development, and the right to peace, among others (Freeland & Ireland-Piper, 2022).

Transitioning from militarization to cooperation

Shifting from a militarized space race to cooperation and demilitarization is essential for expanding human utilization of space. Economic opportunities in space should be prioritized over unnecessary arms races. The existence of space weapons and the principles of deterrence may have unacceptable consequences when used by individuals. We should implement the transition from the military space race to cooperation and enhance the process of demilitarization and deweaponization in space activities, despite the challenges and drawbacks. Shifting towards an economic race rather than a militarized one is currently the most effective approach to expanding human utilization of space. The resources allocated to safeguarding existing capabilities could be better utilized in expanding economic opportunities in space. Allocating resources to an unnecessary arms race only distracts from realizing the economic benefits of increasingly affordable access to space (Townsend, 2021). The existence of space weapons, along with the principles of deterrence, may have unacceptable consequences when utilized by individuals.

Max M. Mutschler in his work, "Security Cooperation in Space and International Relations Theory" (Mutschler, 2015), examines the applicability of different theoretical perspectives in explaining the dynamics of security cooperation in the realm of space. Neorealism, which focuses on the anarchical nature of the international system and states' pursuit of power and security, provides an explanation for the absence of formal security cooperation. According to neorealism, the unequal distribution of gains and the fear of relative losses impede states from engaging in cooperative efforts, particularly in the context of arms control agreements. However, neorealism encounters difficulties in elucidating the tacit form of security cooperation observed between the United States and the Soviet Union during the Cold War. This raises inquiries into why the United States, despite possessing a technological advantage, did not fully exploit its power in space. On the other hand, neo-institutionalism underscores the significance of interdependence and the establishment of international regimes to facilitate cooperation. Neoinstitutionalists argue that states share mutual interests and that regimes can mitigate the risks associated with cooperation by defining the scope of collaboration, monitoring compliance, and fostering trust among states. Within the context of space security cooperation, neo-institutionalists highlight the interdependence generated by the reliance on space technology and the imperative for sustainable space utilization. They contend that an arms race in space poses risks to the benefits derived from space activities, thereby rendering cooperation desirable. Nevertheless, the fear of non-compliance and the challenges associated with defining and verifying adherence to a ban on space weapons present obstacles to effective cooperation.

Constructivist/liberal perspectives center analysis on the role of ideas, norms, and learning processes in shaping state behavior. These accounts argue that actors' perceptions of problems and interests are influenced by their beliefs and knowledge. Epistemic communities play a pivotal role in promoting new interpretations of reality and advocating for policy changes. In

the case of space security cooperation, constructivist/liberal accounts underscore the influence of dominant beliefs that prioritize unilateral behavior over cooperation.

In conclusion, the author mentioned that while each theoretical perspective offers valuable insights, none of them fully captures the intricacies of security cooperation in the domain of space. The analysis underscores the necessity for a multidimensional approach that encompasses systemic, institutional, and ideational factors to achieve a more comprehensive understanding and foster effective cooperation in this field. Further research is warranted to explore these dynamics and develop strategies for enhancing space security cooperation (Mutschler, 2015).

Conclusions

This research emphasizes the need for a systematic and comprehensive approach to tackle escalating space threats and ensure global space security. To achieve this, several key points must be considered.

Firstly, the concept of "space security" should be expanded to encompass its three-dimensional nature and recognize its interconnectedness with global security. This broader understanding will enable a more holistic approach to addressing space threats.

Secondly, increased protection of human rights in space activities is crucial. This involves safeguarding the right to access space, ensuring privacy, benefiting from scientific progress, and addressing concerns related to life, the environment, humanitarian law, and military conflicts. Incorporating the principles of "common genesis" will contribute to a more inclusive and equitable approach.

Thirdly, a shift from a military space race to cooperation, demilitarization, and deweaponization is necessary. By focusing on economic opportunities in space, we can utilize resources more effectively and avoid unnecessary arms races that hinder the realization of the economic benefits of space exploration.

Additionally, it is imperative to promulgate well-defined regulations and precise delineations concerning these matters, particularly in relation to the terms "peaceful" and "nonaggressive" within the context of space activity.

To ensure the preservation of space security and the well-being of humanity, it is vital to address space threats urgently. This requires comprehensive analysis, global legal regulations, and cooperation among various stakeholders. Human rights should be incorporated into the principles, recommendations, and normative legal frameworks governing space activities and space security. In the context of current trends such as deglobalization, the space race, militarization, and the escalation of military conflicts, it becomes even more critical to act swiftly and collaboratively.

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Space Products and Space-Made Products – Different Views on Space Manufacturing in Space and Patent Law

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In-Space Manufacturing (ISM) is a form of space activity that assumes the possibility of manufacturing, processing, and assembling products that use one or both of the following key elements: a) extraterrestrial raw materials as the basis for their production in part or in whole: b) natural phenomena and conditions occurring in extraterrestrial environments, such as microgravity, extreme temperatures or higher vacuum levels. This does not preclude the use of ISM terminology for production that does not use either raw materials or extraterrestrial conditions, but is production that occurs on board or with the use of a space object. For this reason, space production will come into contact with activities such as space mining or the use of space resources in-situ (ISRU), On-Orbit Servicing (OOS), or active disposal of space debris (Active Debris Removal, ADR), and over time will be intertwined with other activities in space. The subject matter of this paper is the term „space product". This term is most often used, apart from legal terminology, for products based on research carried out in space, adapted for their possible introduction into economic circulation (such as fiber optics, cultured organs, metal alloys, ready-made parts and construction elements for satellites and surface stations). Legal considerations regarding the space product focus on two basic issues – first, the applicability of patent protection on board the facilities where production would take place; secondly, the legal status of a space product that would be located outside the manufacturing or assembly facility. Therefore, the aim of this paper is to seek an answer to the question – to what extent do the products of space production coincide with the space products proposed in the literature? What are the consequences of treating them as separate institutions in space law like patent law? What is a possible solution to such a problem?

Keywords: space manufacturing, space product, space object, space resources, patent law.

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Introduction

In-Space Manufacturing (ISM) is a type of space activity that involves manufacturing products beyond Earth, within or with the use of purposefully designed space objects. It is also the field of manufacturing which utilizes the specific phenomena occurring in outer space and on celestial bodies, such as microgravity (Gaertner, 2016), a wide range of temperatures, natural vacuum, or natural resources, such as minerals or volatiles. Products of such activity are most commonly known by the term "space products," and they are widely discussed in publications in the fields of engineering, materials sciences, or even economics. They, however, are not much discussed in the works concerning space law. On the other hand, space resources and their commodification and has been broadly and deeply discussed in works on space law, though more as a form of wealth than a basis of any production, construction of Off-World logistics. Thus, the discussions on the legality of space resource activities are more focused on then interpretation of Article II and VI of the Outer Space Treaty of 1967, the concept of Common Heritage of Humankind and possible adoption of the Moon Agreement of 1979 as customary law, as opposed to discussing the in-space use of space resources. Thus nearly completely ignoring the case for ISM as part of small-scale ISRU or larger, industrial scale space mining operations. We can assume that in the 1970s and 1980s the notion of "space factories," or "space manufacturing facilities," revolved around humans and machines producing commodities in microgravity within said factories, which were treated basically as space objects, no different in their international impact than artificial satellites. Thus it was assumed – that what happens on board a space object, stays on said space object, with no concern to the international community. Any regulations regarding such factories and their operations was left to the states parties to the OST, based on Article VI and VIII of said treaty. They were of no immediate concern to the international law community, and discussions surrounding their regulation can be correlated with the development of reusable launch vehicles (such as the STS program, or modern reusable rockets and vechicles). Therefore little to no progress was made in the last years regarding the regulatory aspects of ISM and its products, as they were both heavily tied to the reusable launch capabilities of developed nations, as well as their basic operations was not much different from other space satellites in Earth orbit.

However, products of space manufacturing, being the effects of the operations of a space object possessing manufacturing capacities, have not been properly discussed in law studies. There are two instances, where ISM products are being mentioned or discussed. These are "space products" and "space-made products." The term "Space products" refers to products of space manufacturing in relation to commodities produced using features or phenomena such as microgravity, which are being manufactured onboard space objects, yet are not suitable, designed, or considered for use beyond the object or in the environment of outer space. They are mostly being used to discuss the problem of patent protection in space object operations and importations of manufactured goods from space or between space objects. The term "space-made products" refers to products of space manufacturing made for the use in outer space, and most notably, with the use of space resources. These are basically "objects manufactured in space," as they possess similar legal recognition to classical space objects.

This work will distinguish between space products and space-made products while discussing their similarities, differences and problems with their possible overlapping, or lack of thereof.

Space objects and space-made products

A space object is an artificial, anthropogenic[1] device launched into outer space or landed on a celestial body that is used in a space activity. The institution of a space object is deeply tied to the basis of international space law, especially the 1967's Outer Space Treaty, the Liability Convention, and the registration convention. According to Article VI of the OST, state parties are responsible for the authorization and supervision of space activities carried out by government agencies and private entities (nationals). They also bear political responsibility for the actions carried out by their nationals or authorized activities. Space activities are being carried out using space objects, which according to Article VIII of the OST are considered quasiterritories of their State of registry. This status allows state parties to the treaty to retain jurisdiction and control over space objects they carry in their registry. It needs to be recalled that ownership of a space object is unaffected by either its presence in outer space or its return to Earth[2]. That said, a space object is a form of an appendage or pseudopod of the State which have authorized its operation in outer space and carries it on its space registry, while extending its jurisdiction and control only to the physical limits of that space object.

The definition of a space object and its form depends on the law and practice of the State of registry or the State which first authorized its operation. There are several problems with maintaining a proper registry of all space objects launched or obtained via ownership change (Von der Dunk, 2017). Some of them stem from inefficient bureaucracy, lack of proper regulations or purposeful neglect on behalf of a state. The most frequent cases of lapse in registration are undisclosed "spy satellites" (Hecht, 2001), or commercial satellites whose registration has been changed on the basis of intergovernmental contracts or change of ownership via purchase by foreign entities (Nelson, 2018). According to Article 1 of both the Liability and respectively, the Registration conventions, space objects are defined as space objects, their components as well as their launchers and their respective components. National space regulations range from "any object" launch into outer space to every object designed for use in outer space and launched into outer space (Hearsey, 2012). There are instances where states do not have definitions of space objects, yet use specific terms like "space vehicle," "space station" or "Space satellite" (Cheng, 1997). The term "spacecraft" appears in the 1968 Rescue Agreement. To be more precise, it is the lawmaker and the proper administrative bodies which decide whether certain devices can be registered as space objects. It can become complicated when a state provides different administrative and legal provisions for satellites and space vehicles and how jurisdiction and control are being regarded within those devices. Registration of a space object is performed as an administrative act, which is considered the creation of a space object, even if such an object is already present in outer

[1] In order to avoid the use of terms like man-made or human-made the term anthropogenic is applied, as it is used not only in relation to the human hands which manufactured a device, but the originator of the lineage of a device. Thus space objects manufactured by machines, which in turn were manufactured by different machines, that were then made by humans are to be considered anthropogenic. The other case for the use of this term is that any "non-human artifacts" that would be found in outer space, as discussed by SETI and SETA researchers will not be considered a space object, nor will any such artifact be considered a "celestial body." This includes artificial structures of complex indigenous organisms found beyond Earth. Artificial structures created (by desing) by Terrestrial organisms brought to the surfaces of celestial bodies beyond Earth might be treated as space objects, if appropriate national laws allow for their registration as such.

[2] Needs to be clarified, that article VIII may be interpreted as considering all objects, even those not registered as space objects.

space or has not been launched yet (Jakhu et al., 2018). The legal consequences of establishing a space object by the State turns this artificial object into a closed quasi-territory, subject to national jurisdiction, regulation and control, within the expanse of *ius spatiale*. Similarly, the modules which comprise the International Space Station, according to the Intergovernmental Agreement of 1998 (IGA), should be registered with their respective States. Though because of the number of modules, and the requirements of coordination and integrating, the station is subject to the provisions of the IGA and subsequent rules and standards set by contracting states and partners. States who are party to the Artemis Accords are committed to cooperate on maintaining proper registration of space objects which are involved in the Artemis program (Section 7, 2020).

However, any extension of space activity may become troublesome when employing new elements to existing space objects and systems. Especially if said elements are being manufactured or constructed using space resources. It begs the question of whether an object manufactured in outer space, can be treated as a space object. Currently, there is no binding act of international space law that would settle this issue outright. On the other hand, as the international space law community lacks any consensus on the proper interpretation of Article II in regard to space resource operations, there is still a lack of clarity on whether the term "constructed" used in Article VIII of the OST allows for treating elements of the space installation produced from space resources as an integral part of the space object.

Addressing this concern, the Hague Workgroup has created the term "space-made product," which is defined as: "a product made in outer space wholly or partially from space resources" (Building, 2019). Article 6 of their building blocks states, "The international framework should provide that States have jurisdiction and control over any space-made products used in the space resource activities for which they are responsible." This institution of "space-made product" was introduced in order to allow state parties to the OST the relevant basis for retaining jurisdiction and control over objects and components produced with the use of space resources. Therefore, a space-made product, whether working as an independent unit or becoming an integral part of another space object, would have been treated in a similar manner as traditional space objects. However, a question ensues from the very start: is the status of such space-made product effective erga omnes? And if so, will the space object registry be suitable in order to place an object not launched from Earth but created on a celestial body and most importantly, from its resources? Additionally, there is the issue of such an object manufactured in space lacking a "launching state," as it was mostly created in situ or no means of launching were involved in its transportation or assembly. Yet one's space-made products, especially complete devices such as rovers, robots, launchers, tugs, or satellites, might pose a risk to other state parties space objects, if there is no liability attached to them. That is the problem of contemporary space regulations and states neglecting the issue of possible collision risk and mitigating it by not registering a space-made product as a space object, which has been launched or deployed from a space or lunar platform.

As far as space law is concerned – it is up to the state party to determine whether their regulations allow or prohibit space manufacturing activities, especially involving the creation of space objects beyond Earth. An example of such national regulation might be found in the proposed, though never passed, *American Space Commerce Free Enterprise act* (H.R.3610, 2019). Its provisions included the definition of a space object, among which we find an object manufactured in outer space. Given that the SPACE Act of 2015 introduced the right of US persons to search, mine and utilize space resources, it is not unreasonable to view space-

manufactured objects as being a product of utilization of space resources. The condition stated in the proposed law was that the object is able to operate autonomously, i.e. outside and without the aid of the object which has manufactured it or assigned it. Any product intended for internal operation or to be dependent and tied with the "mother" space object is not to be considered a space object on its own, but rather an equipment of the initial object.

This poses the issue of whether any such space-made products or space-manufactured objects are to be considered space objects in the same manner as classical space objects referred to in the canonical space treaties comprising the International Space Law. Other state parties to the treaties might object to treating space-made products and their counterparts as space objects in accordance with both the liability convention or registration convention, thus the application of the provision of article VIII of the OST to them. Yet the moment they are introduced into the national space object registry, the ability of other state parties to object to the registration of such objects is very limited. It is the separate treatment of space manufactured objects or space-made products from space objects which creates a legal divide and the basis for other state parties to object to the treating og them as if they were equivalent to space objects. It is this small difference that creates a bigger issue, which will be discussed later in this work.

Space products

A space product does not appear in any binding act of law. Rather it is a concept that is being discussed in works regarding space-based economy (Engelbert & Harper, 2022; In-Space, 2022), materials and life science in outer space (Seoane-Viaño et al., 2022), orbital manufacturing (Bi et al., 2022) and patent law (Burk, 1991). Its relations to space law are minuscule, as manufacturing of a space product falls under national provisions for authorization and supervision under article VI of the OST – as they mostly do not affect any other space object besides their manufacturing space factory (Abeyta, 2017). In the legal context, space products are mostly, if ever, discussed through the lens of applying patent law into activities carried out onboard space objects (Farnesi, 2019). As patent law has strong relations to technology, manufacturing, substances, processes, methods and apparatuses, or even software and organisms can be patentable subject matter, it is reasonable to assume that patent protection should apply to technologies used in outer space, within the confines of a space object.

Thus space products are mostly considered articles of manufacture that are being produced during the process of manufacturing in outer space, but are not destined to function outside of a space object or as a separate entity. Their main role in the legal discussions is limited to discussing how patent law applies to space objects and their quasi-territorial status, as artificial extension of State's national laws (Opinion, 2021). This narrows down the majority of discussions on the application of national patent laws to space objects to the interpretation of their doctrines, case law and regulations through the scope of the limitations set by space law (both national and international) and the environment of outer space. This involves the problems of import, export, infringement, exhaustion, permissible repair, and self-replication of products and technologies which are embodiments of a patent-protected invention. Thus space products can more frequently be seen as means for discussing method patent's infringement on board of a US-registered space object or if such products are even eligible for patent protection, as some argue that use of space resources might be the reason to reject a patent application for an invention. On the other hand, we do have patent examination policies

providing that obtaining a terrestrially producible substance, such as a protein crystal, by means of microgravity manufacturing might be eligible for patent, even if the terrestrially produced variant of the substance is already protected by patent (Seide, 2002).

Can a space product also constitute a space-made product?

Taking into account our previous considerations, it is reasonable to try to answer the question – can space products and space-made products be the same thing? While both are products of ISM activities, and they most certainly do overlap, they aren't (innitially) the same. A space-made product can be a device, tool, filament, structural element, which does not need to be used outside of a space object which manufactured it. A space product can constitute the material basis of a space-made product, which by that point would also serve as a functional extension to a space object or an integral component of such. Space-made products can be transported down to Earth, while space products can remain onboard or be traded between objects and crews as equipment and supplies for onboard use only.

This intersection and overlap, however, has its distinctions. A space product might not be registered as a space object or a space-made product, the same way as a space-made product might not constitute an embodiment of a patented invention. That said, we need to keep in mind that a space object might constitute both a patentable subject matter, a patent-protected invention, as well as the territory where said patent can be protected according to national patent law. One of the best examples for that might be a light sail, sometimes called a solar sail. A particular variant of a light sail might be eligible for patent protection as a method or apparatus, while at the same time, it constitutes a component of a space object, which according to Art VIII of the OST, shall fall under the jurisdiction and control of the State of the registry. Thus a space object can become both the physical area of protection of a patented invention in outer space, as well as the embodiment of the protected invention. This leads us to assume that no matter what the actual diameters and shapes and embodiment of a protected invention takes, it is protected on the whole physical area which constitutes the space object, as if it was being made or used or sold on the soil of the State of registry. To reiterate, a patent-protected invention of which the embodiment is not larger than a 10cm cube is protected on the entirety of a 400m long space object – including its structure, interior and exterior. Thus while a single embodiment of a protected invention might fall under the exhaustion, if the purchase was made with the patent holder or its licensee, manufacture and use of additional embodiments of a similar device on said space object, without the consent of the patent holder, will constitute patent infringement. Furthermore, the same protection applies on every space object under the jurisdiction of the State of registry (Agi, 2022).

Yet the question remains as follows – can a space product also be a space-made product or to put it differently: Can products of ISM activities become space objects? And if not, what status shall they bear? As we have presented earlier in the paper, space products are not a concept recognized by space law, and space-made products are only a proposal for space law. While these two institutions can be used interchangeably in discussing ISRU, OSAM, ISM and other activities constituting what was once called "Space Industrialization," as a matter of space law, those two will remain separate intersecting entities. There is no provision in international space law that would prohibit states authorizing ISM activities from recognizing extensions and additional components to their space objects as artificial objects and installations over which they would retain jurisdiction and control. Even if said objects and components were produced

with the use of extraterrestrial minerals or the use of microgravity. However, it is up to their national law to properly ascribe the title of Space objects to them. This is because national regulations on registering space objects can be at odds with other fields of law, such as patent law. Suppose a State party decides to authorize space manufacturing activities. In that case, their authorization does not equal the registration of any or every product manufactured as space objects in the space objects registry. This, in turn, creates a loophole for one's nationals or foreign entities to exploit.

The legal status of a space object conveys a special status that is effective *erga omnes.* Alternatives to "space object" which are not registered as one might not be able to successfully project States jurisdiction and control over the artificial quasi-territorial object in question. Thus if national law provides that national protection of patents in outer space only on space objects registered within that State, then the terms of patent protection do not apply on material objects which are not registered as space objects. And that, in consequence, provides potential national entities with an opportunity to make, use or sell a patented invention, which would be qualified as a space product or space-made product in our reasoning without infringing on protected patents. This is because, if taken literally, patent protection does not extend to artificial objects placed or manufactured and assembled in outer space, which are not registered as space objects in the national registry of space objects. State party may circumvent this conundrum by enacting national laws which would provide that such "non-space objects" are to be treated as if they were national territories or space objects for the purposes of enforcing patent law or administrative provisions relating to other provisions, such as export control.

However, the lack of proper registration or difference in practice, such as assuming that objects created by space objects are automatically treated new space objects, over which the State of registry of the space object serving as a "factory" or the mothership will further retain jurisdiction and control, may cause further complications or lack of certainty in space activities involving ISM and ISRU operations. Creating additional registries for "space-made objects" or space products that are destined to become components of future space objects only solves the problem on the national scale, or operational scale, if such registries were to become the staple of lunar operations under the future developments of the Artemis Accords. Yet non-Artemis States or blocks might refuse to recognize space-made products or space-manufactured objects as conveying the same rights and obligations as "conventional" space objects.

Space products remaining outside of space objects

There is another issue to the relation between space products, space-made products and space objects. If space products do not constitute space objects, as they are neither registered as such nor become space-made objects in accordance to provisions of national ISM/ISRU law, then what are they? What is their status within space law?

The problem with space products placed intentionally or accidentally outside of space objects they were produced at resides upon the limitation of the scope of international space law. International space law finds, but does not describe in detail: outer space; celestial bodies; objects launched into outer space or space objects; astronauts; installations.

While the Moon Agreement of 1979 did provide that equipment shall be treated as space objects in accordance with the Rescue Agreement and shall be returned to the rightful owner, the treaty has not reached much acceptance among spacefaring nations, and recently some parties have begun to withdraw from it. That is not to say that some of its provisions regarding

space objects cannot be reused in future space treaties or contractual acts of space law (like the ISS IGA or the Artemis Accords). However, contemporary space law will face a challenge with unregistered space products, be it tools, processed materials or articles of manufacture being left outside of their respected storage, operation or manufacturing facility. As they are neither considered space objects nor space-made products, their status becomes property. International space law won't recognize space products as something between a space object and a celestial body, the same way it does not recognize any form of real property in outer space. It does, however, recognize chattel and movables. A case can be made that Article VIII of OST applies to objects manufactured in outer space in a specific manner – it does not provide space products with the status of space objects, yet it clearly states that ownership of an object won't be affected by its presence in outer space or landing on Earth. This does imply that any personal rights towards movable property in civil law states as well as chattel in common law states remain unaffected by the sole fact that a space product was placed outside of a space object. Space products not being recognized as space objects do not carry over the jurisdiction and control of a state, especially on whose registered space object their production or manufacturing has occurred. Only their owner retains any rights and might even allow third-party rights to be attached to them. That however does not convey application of patent protection on space products which would otherwise comprise a working space object, but have been assembled outside the space object of their creation.

That State of affairs causes one to recall Article VI of the OST and rethink the whole concept of authorization and supervision. While private entities in outer space are bound to national laws of the State of registry and the State which authorizes their space activity, States need to either require strict reporting of any space products on board of their respective space objects or prohibit "production without authorization" (Tatsuzawa, 1988). In the case of manufacturing products that might constitute elements of components and of space objects it might be more reasonable that every instance of such manufacturing to require prior authorization and reporting afterwards. In the case of onboard tools and spares such reporting is not of much importance, and especially, when a state authorizes numerous manufacturing stations or crewed stations serving other purposes are provided with onboard manufacturing capabilities (like 3D printers). In the lack of any proper authorization and supervision over miniscule manufacturing activities, which might amount to creation of "no-man's space objects," consequences of neglect can (legally) be dire.

As we understand, the "astronaut's hand" does is a means of space activity, it does not create or assert any right to the astronaut, especially to a non-registered artificial object found in outer space (Anderson, 2008). While states which apply the extraterritorial doctrine to national patent law, might view the use by an astronaut of a foreign or non-registered device in outer space as "beneficial use," said space product might not be considered one nations property by the of one national, covered in a space object which is his space-suit, by the act of physical contact or operation. It may be controversially viewed as an instance triggering Title 35 art 105 (Shoemaker, 1999). However, said paragraph only applies to space objects under jurisdiction and control, and the mentioned space product does not constitute a space object.

Conclusions

Space products and space-made products, although connected via technologies and the place of their creation, come to be different topics of discussing the legal aspects of space

industrialization. Both of them pose challenges to space law, although in different areas. While space-made products pose a challenge to the idea that only space objects can serve as a medium of space activity and be treated as an extension of jurisdiction and control, space products create a different set of problems for state parties and private owners. The most reasonable and responsible for state parties authorizing ISRU and ISM operations would be to provide a proper regulatory framework and registry for objects and items produced in outer space, it is clear that such regulations will require international consultations and harmonization down the line.

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Global Security: Ukrainian HOPSIS Program and Space Mission to Destroy Asteroids

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The article highlights the actual problems of ensuring the Global Security of the World and Ukraine. The results of studying the experience of the Geneva Center for Security Policy and the legal provision of security are presented. The article presents the results of the Ukrainian experience of participating in the mission of the Geneva Center for Security Policy in terms of ensuring Space Security. The problem of Asteroid Hazard is singled out, and the possibility of its elimination using the Science & Space LLC launch vehicle as a carrier of kinetic weapons is described. The legal basis for the use of weapons in outer space and the inevitability of liability for their use are considered – even in the kinetic missile version, which is not a weapon of mass destruction. The world experience in the topic of Global and Space Security under study is considered.

Keywords: space law, global security, space security, space activity, kinetic rocket, anti-asteroid defense, surveillance program.

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Introduction

The globalization of the world today has also identified the problems of Global security. There is a particular need for reconstruction to improve the security and resilience of the state. This includes reducing Ukraine's strategic vulnerabilities (trade routes, energy dependency). It does not diminish the pertinence of human security but calls for a balanced and multi-pronged approach to reconstruction. In democratic societies, human security and state security are interconnected components that complement each other. Only when people are adequately protected against the wide range of threats that they face can society become truly resilient. Human security can therefore be a vital piece of the reconstruction (Greminger & Lunding, 2023).

The authors studied the experience of the work of the world center for ensuring global security, created in Europe: Geneva Centre for Security Policy (Geneva, 2023). The activities of this Center are multifaceted and comprehensive. It is based on the international law and international security programs.

The work also analyzes the Space Security Program of Ukraine: Open World – Ukraine: Orbital Prosperity of Humanity Through Safe and Industrial Space (HOPSIS). In addition to the above, the authors consider the use of kinetic weapons as part of specialized Asteroid Defense (AD) to destroy an asteroid in outer space or in the Earth's atmosphere and the possibility of creating a non-nuclear, non-explosive analog of asteroid damage even before they hit the Earth's surface.

Geneva Centre for Security Policy

The Geneva Centre for Security Policy (GCSP) has its roots in the Geneva Summit of 1985: the first meeting between US President Ronald Reagan and Soviet General Secretary Mikhail Gorbachev to discuss international diplomatic relations and the arms race in the midst of the Cold War.

In 1995, Mr. Adolf Ogi, Swiss President and Federal Counsellor in charge of the Federal Department (Ministry) of Defence, initiated the establishment of an international Foundation in Geneva to expand the reach and impact of the course and serve as a contribution of the Government of Switzerland to peace in Europe. 11 States accepted to nominate a representative to serve on the Foundation Council (board of trustees).

The Geneva Centre for Security Policy's (GCSP) mission is to advance peace, security and international cooperation by providing the knowledge, skills and network for effective and inclusive decision-making through executive education, diplomatic dialogue, research and policy advice. GCSP can successfully achieve these goals by constantly and timely focusing on the Medium Term Strategy for 2023-2027 are able to successfully achieve these goals by our continued and timely focus on our Medium-Term Strategy 2023-2027 (MTS). The GCSP's mission was strengthened, when in 1996, Switzerland joined the Partnership for

Peace (PfP), an initiative led by the North Atlantic Treaty Organisation (NATO) to enhance transatlantic security cooperation. GCSP was a Swiss contribution to the PfP and is now recognized as a Partnership Training and Education Centre (PTEC). GCSP has created an inclusive environment for a global community of 184 countries and sectors to come together to exchange ideas and develop sustainable solutions for a more peaceful future.

The governing body of the GCSP is the Foundation Council, which consists of representatives of 52 Member States and the Canton of Geneva, incl. and the State of Ukraine, which joined the GCSP in 1995.

In 2019 GCSP analyzed the OCSE mission in Ukraine with the aim of preventing conflict and achieving peace (Lessons, 2019). This conference was attended by Mr. Alexander Hug, former Dep Chief Monitor OSCE Mission to Ukraine (Vienna). There is no information about the participation of Ukrainian state representatives in the conference, as well as there is no information about the participation of the state of Ukraine in the work of the GCSP in general since 1995. It is only known that diplomat Maxim Kononenko, Ambassador Extraordinary and Plenipotentiary of Ukraine to the Republic of Estonia, completed a training course at GCSP: Executive Program on the Legal Aspects of the Current and Future Use of Force, Geneva Centre for Security Policy (GCSP) (Geneva, Switzerland), October 2017. Other Ukrainian specialists also received personal training at GCSP.

But this does not mean that no one from Ukraine is participating in GCSP missions.

On March 17, 2022, a discussion of the issue of Ukraine took place at a meeting of diplomats, "Breakfast Debrief on the War in Ukraine, with Club Diplomatique de Genève" (Breakfast, 2022). Diplomats of Ukraine did not take part in the meeting. On April 13, 2022, a discussion of the topic took place, "The War in Ukraine: Repercussions in the World and in the Middle East" (Chalyi, 2023). Ukrainian government officials did not participate in the meeting. On September 5, 2022, a debate was held at GCSP on the topic "Impact of the War in Ukraine on Multilateralism and the World Order – A Geneva Security Debate" (Impact, 2022). Ukrainian representatives did not participate in the debate. On February 24, 2023, a debate was held at GCSP, "The Humanitarian Response – Marking the One-Year Anniversary of the War in Ukraine – A Geneva Security Debate" (Humanitarian, 2023), without the participation of Ukrainian representatives. On July 7, 2023, in GCSP was discussed topic "Ensuring Long-Term Peace in Ukraine: What Solutions?" (Ensuring, 2023).

The discussion was attended by Mr. Andrej N. Lushnycky, President of the Ukrainian Society in Switzerland and honorary consul of Ukraine in Switzerland.

GCSP is registered in Geneva as a non-profit Fund, but, in addition, responds to modern challenges: the GCSP is ISO 9001:2015 certified**.** ISO 9001:2015 is an international quality label that specifies the requirements for a quality management system within an organisation.

Among the activities of GCSP is Space Security (The Future of Outer Space Security), which is the focus of this study.

Outer space must be kept secure as a global commons for all of humanity. This involves proactively dealing with issues such as space debris and the weaponization of space. At the same time, this must be reconciled with the reality that the security of a state's space interests is vital to its national interests. In recent years, space weaponization has escalated and caused tensions to flare between some countries.

It includes sessions led by international experts on the following topics: Cybersecurity and space security, Space debris, Space weaponization, New space (industrial development of outer space), Space power and policy, Space governance.

Open World – Ukraine: Humankind Orbital Prosperity by Safe and Industrial Space (HOPSIS)

It should be noted that in Geneva, the GCSP pays a lot of attention to the problems of security and peace in Ukraine, as a component of global security. Research Institute of Space Industrialization (ISI) (Research, 2023), the office of which is located in Ukraine, unites specialists and scientists of various fields of activity from different countries who have a good understanding of what security is and, in particular, Space Security. ISI supports the activities of an international organization in Geneva and participates in the GCSP program Prize for Innovation in Global Security.

The Institute, together with the National Space Facilities Control and Test Center (State Space Agency of Ukraine), is implementing the Open World – Ukraine: Humankind Orbital Prosperity by Safe and Industrial Space (HOPSIS) (2013-2023), a program aimed at monitoring near-Earth space and the introduction of new rocket and space technology that does not pollute space with debris.

The program aims to ensure space security and control of near-Earth space in the global security policy (Open, 2023). The program considers threats in ensuring space security: space debris; militarization of the Cosmos; natural impact on the Earth from space.

Technogenic and military manifestations in space can be eliminated in four ways: exclusion of man-made junk by replacing disposable space technique on returning to the Earth reusable Spacecrafts (Orbiters) (Levenko et al., 2016) and return to the Earth and elements of Launch Vehicles (reusable LV) (Levenko et al., 2014): asteroid impact avoidance; observation and control of space objects; space monitoring and analysis system.

Prevention of technogenic (man-made) of space debris (2013-2023)

The non-used satellites, the rocket stages and the space boosters flying in near-Earth space, in the 21st century, accumulated in such quantities that they are dangerous for flights in space now. After the operation, such objects were not originally planned to be returned to Earth. They gradually lose altitude and burn in the Earth atmosphere. However, this process is stretched for decades. And the pace of satellite launches is such that previously launched objects do not have time to descend from their orbits. As a result, the problem of "space junk" (space debris) has appeared. Research Institute of Space Industrialization (ISI) offers an engineering (technical) decision: only the returned spacecrafts (Orbiters) need launched into Space; launch vehicles and rocket stages return from orbits to Earth.

Any modern satellite can be maneuvered on Earth's orbits to avoid collisions with other objects, and it can be returned to Earth – it's Orbiter.

Research Institute of Space Industrialization has analyzed and developed three models of Orbiters: weight up to 50 kg, Orbiter USC-50-X; weighing up to 500 kg, Orbiter USC-500-X; weighing up to 1000 kg, Orbiter USC-1000-X (Directions, 2023).

According to the authors: until the launches of disposable spacecraft into high orbits stop, the problem of "space debris" will not be solved.

ISI offers engineering solutions: only returning satellites and ships should be launched into space (Orbiters); launch vehicles and rocket stages must return from orbits to the Earth.

This can be done technically. However, administrative measures need to be taken to ensure the implementation of technical solutions in a legal framework (Space governance – as

interpreted by the GCSP, based on UN decisions, international agreements, in particular, the Outer Space Treaty (OST), 1967: on the peaceful use of space).

Asteroid impact avoidance (2020 – 2023)

According to current forecasts, asteroids 50-70 m in size can fall to the Earth in the period of up to 90 years and cause significant damage to the Earth's surface. To ensure space (asteroid) safety, planetary duty can be organized to detect, intercept and destroy approaching asteroids of this size. On duty, there may be an interceptor missile (launch vehicle) with a 200-500 kg metal kinetic interceptor (payload of a space apparatus).

According to the calculations, the asteroid may be destroyed at an altitude of about 80-140 km (Space, 2023).

As early as 1995, the United Nations Office for Outer Space Affairs (UNOOSA) organized the United Nations International Conference on Near-Earth Objects (Cowing, 2013). UN Scientific and Technical Subcommittee at the 50th session on February 22, 2013, in Vienna, endorsed the report of its Working Group on Near-Earth Objects (NEOs) that recommended the establishment of an international asteroid warning network (IAWN). A Space mission planning advisory group (SMPAG) should be established by those Member States of the United Nations that have space agencies. This means that the State Space Agency of Ukraine should take the initiative.

The group was created in 2014, under the name Space Mission Planning Advisory Group (SMPAG). In 2016, the SMPAG set up an ad hoc working group to address legal issues related to its planetary defense methods, in particular, those related to the use of «weapons» (Barug et al., 2020).

A State would potentially incur international liability through the use of impulsive methods such as conventional explosives or nuclear explosive weapons (in accordance with the Outer Space Treaty (OST) requirements), Partial Test Ban Treaty, Treaty on the Prohibition of Nuclear Weapons (TNPNW). Weapons for the destruction of asteroids should not be analogous to weapons of mass destruction – according to the authors, it should be a kinetic precision weapon.

Nevertheless, when creating a kinetic weapon, liability may still arise in the event of an accident or a change in the asteroid's flight path, which will entail a blow to the territory of a state that did not use weapons against the asteroid: constructive measures must be taken to prevent such a situation. Absolute liability would mean that even if the State that launches the weapon takes all measures to avoid the error, but the error still occurs, it would be held liable. This risk could severely limit any planetary defense initiative by some States.

The need for additional rules on planetary defense is indisputable, but the form and scope of such rules remain unclear (Barug et al., 2020).

An asteroid hazard exists, although this event may not occur within the lifetime of one person. However, the impact of the Earth by an asteroid can lead to global consequences, which has already happened in the distant geological past of the planet. According to the European Space Agency: as of April 2019, 20 000 asteroids whose orbit brings them near Earth have been found. At the current rate of roughly 150 new discoveries every month (The day, 2019).

As recognized in the world, the main problem of anti-asteroid defense lies in the plane of international law (Koplow, 2019). NASA and its partner space agencies in other countries, as well as space explorers, have already made efforts to survey dangerous near-Earth objects

(including flights to asteroids in the United States and Japan), and some methods have been developed that could be used to deflect a dangerous asteroid.

The most promising route considered by the panel for addressing both these legal issues is to exercise the powers of the United Nations Security Council. Under Chapter VII of the U.N. Charter, the Security Council holds a unique law-making ability and possesses the authority to supersede the provisions of other treaties. If prompted by a genuine emergency, the Security Council could therefore authorize states to exert their best efforts for planetary defense.

Such a solution to the legal problem allows Ukrainian specialists to offer their own version of anti-asteroid protection: a space mission to use an anti-asteroid kinetic launch vehicle.

Control on orbits. Observatio of Near-Earth Space

To control the launches of Launch Vehicles, Orbiter space flights, and the landing of Spacecrafts, use the opportunity of the National Space Facilities Control and Test Center (NSFCTC) State Space Agency of Ukraine. Within the framework of the proposed program Open World – Ukraine: HOPSIS NSFCTC can provide information without restrictions. Experience of such work is available: NSFCTC maintains a catalog of celestial objects with the definition of the flight orbits and monitors the trajectories of re-entry Spacecrafts to Earth. Currently, the NSFCTC is exchanging information within the framework of the space programs of the European Union: Copernicus, Proba-V, MetOp, and navigation support systems the EGNOS.

Technical capabilities of NSFCTC can solve the problem of the space militarization: due the control of space objects in the interests of the security of space and the whole of mankind. As of April 2020, 2713 space objects and 12593 space debris objects are controlled. By 2023, the number of objects launched into orbit has more than doubled.

The program Open World – Ukraine: HOPSIS, with its components, eliminates man-made and military manifestations in space. In addition, the Open World – Ukraine: HOPSIS project can provide ground control of global security.

NSFCTC has monitoring and observing equipment:

a) Nature seismic manifestations (earthquakes, information on the site http://nkau.gov.ua/nsau/nkau.nsf/Main1E/indexE?opendocument);
b) Technogenic seismic manifestations (nuclear, thermonuclear and other explosions, launches of heavy Launch Vehicles);
c) Fall of space objects to the Earth (for example, the fall of the Chelyabinsk meteorite). Re-entry of space objects into Earth atmosphere.

The complex of orbital support, control, and management, as well as global terrestrial monitoring, allows eliminating a number of the problems of ensuring the security policy of mankind, first of all, in space security.

The program is implemented in the legal field of Ukraine, considering international agreements.

2020 – space monitoring and analysis system

The Space Monitoring Center of the SMAS (NSFCTC) ensures the collection of information on space objects, administering the Main Catalog and the Catalog of priority space objects;

operational estimation of the orbital constellation and the state of ground facilities; planning of the application of the means of Space monitoring and analysis; formation of messages on space situation and bringing them to consumers of information.

The National Center is working on involving to the SMAS both national and foreign facilities of space objects monitoring (On Space, 1996).

Space mission to destroy asteroids (Ukrainian HOPSIS+AD program)

The energy of meteorite and asteroid impact

The authors conducted a study of the processes of asteroids falling to the Earth and evaluated the consequences of this process. The shock wave in the Earth's crust during the fall of an asteroid of a sufficiently large size is catastrophic: the atmosphere will not be able to extinguish its huge flight speed. For example, the flight speed of the asteroid 99942 Apophis (diameter 325±15 m) is 30.728 km/s. With a mass of this asteroid of 6.1×10^{10} kg, its kinetic energy of falling to the Earth can be $\approx 2.4\times10^{19}$ J. This will be an impact that will cause destruction, an earthquake, volcanic eruptions with atmospheric emissions, and a tsunami.

The results of similar falls of asteroids remained on the surface of the Earth. Одним из наиболее крупных астероидным образованием является Popigai impact structure – crater (Siberia, Krasnoyarsk Krai of the Russian Federation): диаметр 100 км, глубина 200 м, возраст 35,7 млн лет.

Chicxulub crater has a diameter of 180 km, is located on the Yucatan Peninsula in Mexico, partly in the waters of the Gulf of Mexico, and is 66.5 million years old. Scientists estimate that the crater was created by the fall of a ten-kilometer asteroid. The impact energy is estimated at $5x10^{23}$ J (which is 2 million times more powerful than the explosion of the most powerful thermonuclear bomb: the explosion power of the "Tsar bomb" AN602 on October 30, 1961, was 2.4x1017 J). The formation of the crater is attributed to a planetary catastrophe in which dinosaurs became extinct, and the Cretaceous period ended on Earth.

When an asteroid collides with the Earth, the kinetic energy of motion is transformed into impact and thermal energy. All aspects of such a possible catastrophe have already been studied.

An assessment was made of the destruction caused by the fall on the land of the most massive and most probable asteroids and meteorites 10-300 m in size (Shuvalov et al., 2013).

As a result of the analysis, it was determined that destruction on the Earth's surface is inevitable when the size of the asteroid is more than 30 m in diameter. This applies to massively distributed stone asteroids.

It was determined that because of the destruction of an asteroid by an explosion, the falling debris should be less than 20-30 m. This circumstance was taken into account when choosing a method for destroying a dangerous celestial body before it hits the Earth.

Over the past decades, the asteroid-comet hazard has been studied in the world. Potentially dangerous space objects have been identified (Near-Earth Objects, NEOs). Most of the known asteroids are able to cross the Earth's orbit (Earth-crossing asteroids, ECAs) – there are about 800 of them. In addition, long-period comets can enter a potentially dangerous Earth impact orbit as little as two months before they are discovered (Kozelkov, 2014).

This means that anti-astroid weapons must be constantly on "combat" duty: from known technical means, launch vehicles with long-term storage fuel are suitable for this within the "space alert announcement" time.

The most dangerous are local catastrophes from falling asteroids with a diameter of 50 m (the area of destructive impact is 1900 km^2) – the frequency of their probable fall is less than 100 years. Global catastrophes can be caused by asteroids with a diameter of 2 to 10 km: the frequency of their appearance is likely once every 1 to 70 million years. The death of a civilization is probable when an asteroid with a diameter of 100 km falls to Earth (the probability of such an asteroid falling once every several billion years).

To break an asteroid with a diameter of 50-70 m into fragments that will burn in the atmosphere is the main task of protecting the Earth from asteroids, according to the authors.

The LONEOS (Lowell Observatory Near-Earth Object Search) system is operating in the United States to search for asteroids and comets dangerous for the Earth. Under the Near-Earth Asteroid Tracking (NEAT) program, observation stations operate on Maui and at the Palomar Observatory. Monitoring of near-Earth objects is carried out according to the Australian-American project CSS and the project of the European Union countries Asiago-DLR Asteroid Survey (ADAS). The control of outer space is also carried out by the Ukrainian National Space Facilities Control and Test Center, as well as the National Academy of Sciences of Ukraine, its Main Astronomical Observatory (Main, 2023).

An engineering problem that the authors solved: the release of energy from the collision of a mass, for example, a metal block, in a collision with a cosmic body (asteroid). From studies of different years, it is known that even when a bullet is flying at a speed of more than 4 km/s, the thermal energy of the impact turns the target into plasma and has a stopping power. And it is also known that the energy released during the explosion of 1 ton of trinitrotoluene (TNT equivalent) is equal to 4.184·109 J.

Studies on the possibility of using kinetic weapons to change the flight path of the asteroid Dimorphos (diameter ≈160 m) have already been carried out in deep space, DART mission, USA, 2022: at the time of the impact on the asteroid, the spacecraft weighed 550 kg, the impact energy was 1×10^9 J (Tavernier, 2022).

Kinetic launch vehicle

The authors consider the use of kinetic weapons as part of a specialized Asteroid Defense (AD) to destroy an asteroid in outer space or in the Earth's atmosphere. The authors analyzed the possibility of creating a non-nuclear, non-explosive analog of hitting asteroids before they hit the Earth's surface.

It is taken into account that during the collision of moving bodies with a speed of more than three km/s, the kinetic energy of the impact significantly exceeds the energy release of conventional explosives. The use of an asteroid destruction element made of steel as a launch vehicle payload is considered.

The final calculations are presented in the Technical proposal for the creation of a kinetic launch vehicle XXX-1. The calculations took into account the effect of a collision with an asteroid, only the payload of a rocket with a mass of 200 kg (the total final mass of the payload and rocket structure can reach 1000 kg – the payload does not separate from the launch vehicle).

A technical proposal for the implementation of the HOPSIS + AD program with a kinetic launch vehicle XXX-1 is presented by the Ukrainian Science & Space LLC.

If necessary (decision by the UN Security Council), a single-stage launch vehicle XXX-1, using a transitional Hohmann trajectory with repeated switching on of a GS-10 liquid rocket engine, is launched into a circular near-Earth orbit to an altitude of 500 km. After determining the time of impact on the asteroid from this orbit, the launch vehicle with the engine turned on moves towards the asteroid and hits it.

Without taking into account the speed of the asteroid on the opposite course, the speed of the launch vehicle, according to the calculations performed, is 7.8 km/s. The energy released during the collision of the payload of a 200 kg launch vehicle with the surface of a stationary asteroid will be E200 = $1.2x10^{10}$ J (the energy is an order of magnitude greater than in the explosion of one ton of TNT). When performing a mission on the opposite course of the asteroid at a speed at least equal to the speed of the kinetic fighter XXX-1 (taking into account that, depending on the definition of energy, the speed is squared), the impact energy can be $E_{\Sigma} \approx 5 \cdot 10^{10}$ J or 12.4 tons of TNT equivalent. Data on the results of the explosion of 5 tons of trinitrotoluene are known (Adushkin & Khristoforov, 2004): crater diameter 110 m, depth 21.4 m.

With the ratio of the asteroid diameter to the funnel depth of 2:1 for the complete destruction of the asteroid, the obtained parameters correspond to the destroyed asteroid with a diameter of 42.4 m. And with the equivalent of 12.4 tons of TNT, the parameters can reach, presumably, there are no open data on such ground-based explosions, calculation by the extrapolation method: crater diameter 178 m, crater depth not less than 34.5 m: this is enough to completely destroy an asteroid with a diameter of ≈ 70 m.

Consequently, the task of destroying an asteroid with a diameter of 50^{+20} m can be performed.

When designing a launch vehicle, modern trends were taken into account: rocket low-budget (one small-sized stage 12 m long and 1.1 m in diameter, liquid fuel is supplied to the engine without a turbopump unit by gas pressure); the rocket is environmentally friendly and can be stored in a filled form for a year (propellant components: highly concentrated hydrogen peroxide and ethanol), after which the rocket can be refueled. Schematic diagram of XXX-1 corresponds to the launch vehicle GreenSpace company Science & Space LLC.

The main thing: a kinetic missile is not a weapon of mass destruction (with a TNT or nuclear charge), and is not a weapon for destroying spacecraft in Earth's orbit (the likelihood of space militarization), since it can only be used by decision of the UN.

Conclusions

Participation of Ukraine in the work of the Geneva Center for Security Policy to maintain global security in the world is the most important condition for security for Ukraine itself.

An element of such participation is currently the Ukrainian Space Security Program: Open World – Ukraine: Humankind Orbital Prosperity by Safe and Industrial Space (HOPSIS**)**. The program consists of four sections, three of which are being successfully implemented.

Until recently, the task of providing anti-asteroid protection (AD) remained a problem. This problem has been solved and presented by Science & Space LLC in the form of a Technical Proposal for the creation of a kinetic launch vehicle XXX-1 (for the destruction of the most numerous asteroids when they approach the Earth). The kinetic missile is not a weapon of mass destruction.

It is necessary to continue research to form a clear legal framework for the use of weapons to prevent the asteroid threat: this problem can be solved by making an operational decision at

a meeting of the UN Security Council.

The ongoing HOPSIS program is only a part of global security, incl. Ukraine. Ukraine's problems are constantly considered in the Geneva Center for Security Policy, as they are related to global security in the world. But, as a rule, this happens without the participation of representatives of Ukrainian state organizations.

Unlike most other sites of recent international reconstruction projects, Ukraine will be recovering not from intrastate but interstate conflict. The HOPSIS + AD program will provide Human security in Ukraine as a component of the global security of mankind.

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Why Ukraine is Left Without Missile Weapons to Deter the russian aggressor: Political and Legal Analysis

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The article examines political and legal issues of why Ukraine has been left without missile weapons. The authors summarize that Ukraine's international legal obligations limit Ukrainian missile builders to a potential capacity of producing ballistic missiles up to 500 km. However, this is not what is critical. After all, under martial law, Ukrainian legislation favors production of weapons in general and ballistic missiles in particular. However, there is no special public administration body in Ukraine that is responsible for coordinating and supporting Ukrainian private arms producers. The article concludes that the main reason why Ukraine has been left without missile weapons is the short-sightedness on the part of the officials of the Ministry of Defense of Ukraine, domestic financial and industrial groups, and civil society actors. The authors propose an investment paradigm that should guide domestic elites to invest in the production of Ukrainian weapons, in particular, Ukrainian ballistic missiles which could deter the Russian aggressor.

Keywords: ballistic missiles, deterrent weapons, international obligations, national legislation, legal restrictions, international law, Russian-Ukrainian war, arms trafficking.

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Introduction

In the context of the Russian-Ukrainian war, which has been going on since the beginning of 2014, and its most intense stage, which began on February 24, 2022, the problem of military missile production in the country and arms trafficking in general has risen to a new existential level. The production and sale of weapons has always been a very profitable business (Killer, 2019). Total arms sales of the world's largest arms and military services companies (SIPRI Top 100) amounted to $592 billion in 2021, an increase of 1.9 percent compared to 2020 (Lopes et al., 2022). The top 5 countries with the highest profits from its sale include the United States, Russia, France, Germany, and China (Killer, 2019). Competition in this area also remains quite fierce, and the policies of the countries are rather inconsistent. Thus, some countries create some groups and oust their competitors (for example, the US military-industrial companies Martin Marietta and Lockheed merged into the modern Lockheed Martin Corporation, which can only be challenged by the Boeing Company, Northrop Grumman Corporation, Raytheon and General Dynamics (Lockheed, 2023), while others begin to demand the disarmament of other states for the sake of "peace" (Cranston, 2023).

With regard to Ukraine and its place in the arms trade market, it should be noted that for almost three decades in a row, it has been at the top of the list of the world's leading arms traders: 2012 – 4th place in the global arms trade ranking, 2015 – 9th place, 2018 – 11th place (Trends, 2018). But at the beginning of 2014, Ukraine was no longer among the top five, and in 2018 it was no longer even among the top ten. And this is only because the Russian-Ukrainian war has been going on since 2014. And first of all, this is due to the fact that Ukrainian arms manufacturers have had practically no new innovations (not related to the Soviet era).

The same applies to domestic short-range missile systems, which were developed, but none of them have been adopted by the Armed Forces of Ukraine (Halunko et al., 2023). As for longer-range missiles, Ukraine has voluntarily pledged not to develop or produce them (NATO, 2019).

It should be emphasized that legal restrictions on the creation and proliferation of weapons are one of the inherent objective components of missile weapons design that should not be ignored (Fidler, 2003). However, while fulfilling its international obligations, Ukraine remained virtually defenseless against a powerful aggressor, which in turn ignores all international obligations and does not comply with the international rules. So is it still necessary to comply with legal restrictions? We tried to answer this question in this article.

At the beginning of the article, it was proved that in the conditions of war, the Ukrainian people are not adequately protected from Russian ballistic missiles. It is concluded that it is necessary to finalize the projects and start producing Ukrainian missiles to deter the Russian aggressor immediately. The following section focuses on the analysis of the legal restrictions imposed by international and foreign national legislation on ballistic missile designers and manufacturers in Ukraine. It is summarized that Ukraine's voluntary international commitments limit Ukrainian business in the development and production of ballistic missiles with a range of more than 500 km. It has been established that compliance with such obligations in the context of a full-scale invasion of Ukraine by Russian-terrorist forces is meaningless, but it is not the main reason why the Armed Forces of Ukraine do not have effective missiles to deter the aggressor. It is proved that the main reasons for the unjustified sacrifice of the Ukrainian people from Russian missiles are the short-sightedness of officials of the Ministry of Defense of Ukraine, domestic financial and industrial groups, and civil society actors who invest hundreds of billions of hryvnias in the purchase of foreign weapons (which is justified for conventional weapons), but do not want to allocate a meager amount of this (tens of millions of hryvnias) to finalize domestic projects of operational and tactical systems with the ballistic missiles.

The article concludes by analyzing the legislation in force under martial law and concludes that the Parliament and the Government of Ukraine have established good tax conditions for the production of weapons in general and ballistic missiles in particular. As for the organizational aspects of coordination and support of Ukrainian private arms producers, we emphasize that effective public administration as such is practically absent in Ukraine. In this aspect, the establishment of the Ukrainian Defense Industry Joint Stock Company does not solve this problem. After all, the functions of the newly created state institution are mainly aimed at the issues of the state-owned arms production sector.

In general, it is concluded that using the good conditions for the production of ballistic missiles created by the Parliament of Ukraine, private investors and volunteer organizations should unite in order to provide a financially support for the completion of the design and production of Ukrainian ballistic missiles with a short range of up to 500 km. After all, only with Ukrainian missiles will the Armed Forces of Ukraine be able to destroy military targets in Russia, a country recognized by the international community, without asking permission from its partners.

Armed immunity, or can we do without weapons?

Let's start our scientific reflections by analyzing the neutral status of the Swiss Confederation and the level of its armament. Ever since the Middle Ages, the Swiss cantons have been

skillfully defending their well-being. After all, Switzerland adheres to the special concept of "armed neutrality." It provides for the possibility of armed defense in the event of a targeted attack by any country. To this end, Switzerland has always maintained its defense capabilities at a high level. As a result, consistent adherence to the principles of neutrality, readiness to defend its territory, and respect for this status by other states have allowed the confederation to protect itself from various wars and conflicts for a long time (Relevance, 2021).

Thus, the weapon of defense and deterrence of the aggressor is an integral factor, a regulator of good and pragmatic relations in the modern world. It should be noted that Ukraine does not have Swiss welfare. For a long time, Ukrainian citizens have been electing populists of various formats to the Parliament and other representative bodies of Ukraine. One of the consequences of their policy is the failure to adopt a law on weapons. After the beginning of the full-scale invasion of the Russian terrorist forces, the distribution and legalization of weapons in Ukraine were carried out in conditions of extreme necessity. For example, in Kyiv alone, in the first days of the war, more than 18,000 assault rifles were distributed to the Ukrainian citizens, as tens of thousands of volunteers went to defend their homeland with weapons in their hands (Martynets, 2022). At the same time, the crime rate in Ukraine in the first half of 2022 decreased by 25% compared to the previous period (Dziubynskyi, 2022).

Therefore, an effective law on arms trafficking in Ukraine must be adopted. After all, both Ukrainian and international practice show that the presence of firearms among a wide range of citizens is a factor in reducing of a criminal activity and an effective factor in providing armed resistance to an external aggressor. In turn, the uncontrolled (illegal) proliferation of weapons leads not only to instability and armed conflicts, but also disrupts a fragile balance in the global arms market, which is bad for business. In addition, one must also balance on the edge of ethical considerations, which is not something that mafia members are prone to, but which ordinary citizens, for whom the whole world is family, children, relatives, and home, are prone to.

It is necessary to state that Ukraine's security in the context of the war is caught between "two fires": the need for weapons and restrictions on their production. It may seem that Ukraine does not have to produce its own weapons. It can be obtained from partners or purchased. However, the practice of this war has shown that stocks of weapons tend to decrease and disappear altogether. Therefore, it is necessary to have the potential to produce weapons at least to replenish its arsenal (Kulichenko et al., 2022).

The political inclination of the partners is volatile. Even now, they will not allow its use against military targets in Russia. Short-range missiles, which essentially are contact weapons, should be singled out as a separate category of weapons because they are used on the battlefield. Medium- and shorter-range missiles are tactical, they can hit enemy decision-making centers, and military bases and interfere with enemy logistics. Strategic missiles could become a deterrent against any aggressor for Ukraine (Halunko et al., 2023). Thus, there is a need to start developing our own missile industry, for which Ukraine has a proper potential.

Analysis of current legal restrictions regarding production of missile weapons

Any attempts by private initiatives to produce missile weapons always encounter some national and international opposition, and not without reason, as there are objective factors for their restrictions. These restrictions were adopted to prevent the supply of weapons to terrorist organized groups and state sponsors of terrorism. It also should be mentioned that the

international community is wary of other states, including democracies, which develop their own missile technology but are in a state of military conflict with another state.

For example, after the Israeli War of Independence in 1950, the Tripartite Declaration was signed, which limited arms supplies from the United States, France, and the United Kingdom. At that time, Israel had two strategies available to it: purchasing abroad or developing its own defense production. Due to the lack of funds and time for development and production, the country's leadership decided to focus on improving imported weapons. This was also based on the capabilities of the Israeli scientific and engineering community and the realization of how negative the consequences of dependence on imports could have been. At that time, Israel focused on improving and modernizing foreign weapons in which other states had invested countless sums of funds (Plakhuta, 2022).

This is a good example to follow for Ukrainian officials from the Ministry of Defense, who are begging exclusively for weapons from foreign partners and have practically left domestic arms manufacturers without government contractors. If this applies to the weapons that Ukraine's partners transfer to Ukraine without any reservations, then this is to some extent justified. After all, the Armed Forces of Ukraine need it today and right now. However, as for ballistic missiles and long-range cruise missiles, no one will ever provide them to Ukraine. They need to be produced independently, and Ukraine has the design and some production potential to do so. Conventionally, the entire array of legal restrictions can be classified into: 1) international; 2) interstate; 3) national. So let us briefly analyze them.

International agreements limiting proliferation of missile technology

The main international document regulating relations on the production of weapons of mass destruction, which include ballistic missiles, is the Missile Technology Control Regime (MTCR). This regime was initiated by the US government and some other countries in 1987, and 34 states, including Ukraine, signed on to it. The reason for the adoption of the MTCR was growing proliferation of weapons of mass destruction in the world: nuclear, chemical, and biological (Missile, 2023).

One way to counter this threat is to maintain close oversight of the transfer of equipment, materials, and technologies that could be used in weapons of mass destruction delivery systems. Twenty countries are currently engaged in global production of missiles that can deliver a "payload" in the form of a warhead. Missile systems usually consist of four elements: 1) a payload or warhead; 2) a propulsion system that accelerates a payload to the desired speed; 3) a guidance and control system that guides the missile along a programmed trajectory to its destination; and 4) a missile structure that combines all the elements. Both the rocket itself and all its components, manufacturing technologies, process equipment, software, electronic equipment, heat protection, materials, etc., are the subjects to control.

At the same time, the MTCR controls atmospheric unmanned aerial vehicles (including cruise missiles, radio-controlled target aircraft, and radio-controlled reconnaissance aircraft) capable of delivering a "payload" of at least 500 kg to a "range" of at least 300 km. The main task is to narrow the circle of users of missile technologies without proliferating them beyond the MTCR partners (Missile, 2022).

It should be noted that not all the states with ballistic missile production facilities are MTCR partners. For example, the People's Republic of China, the DPRK, the Islamic Republic of Iran, and Pakistan are such countries. To cooperate with them on specific projects, it is

necessary to obtain consent from all MTCR partners. Ukraine adheres to its partnership in the MTCR. There are no proven cases of violation of the MTCR by Ukraine. This is not the case, for example, with Russia, which is a partner of the PRC, the DPRK, and the Islamic Republic of Iran (Levenko, 2020).

In addition, international arms trade uses an Export License, which is a permit issued by an export authority that allows a recipient to export, re-export or perform other regulated actions specified in the application. In the international legal field, these and other similar restrictions are in line with the WA – the Wassenaar Agreement. The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies is a multilateral regime aimed at ensuring regional and international security by promoting transparency and increasing accountability in the international transfer of conventional arms and dual-use goods and technologies (Wassenaar, 1996).

So, in general, it should be noted that the Missile Technology Control Regime does not formally prevent Ukraine from developing of the design, testing and production of missiles with a range of up to 500 km for domestic use and 300 km range missiles built for export.

Interstate agreements among individual states with the participation of Ukraine

Interstate agreements between individual countries on missile technology and missile arms reduction emerged during the Cold War. The main signatories to such agreements were the United States and the USSR. However, given that some USSR republics had their own representation in the UN, including Ukraine, the Soviet republics were also members of such agreements. After the collapse of the USSR, legal obligations remained with the successor countries of the Soviet republics.

Ukraine supports the Treaty on the Elimination of Intermediate-Range and Shorter-Range Missiles Between the United States and the United States of America (INF Treaty) at the legislative and executive levels. This treaty banned all US and Soviet missiles with a range of 500 to 5,500 kilometers. The treaty resulted in the destruction of 430 US missiles and 979 Soviet missiles that had been in storage or otherwise had not been deployed. The treaty hindered the planned deployment of new ready-to-use missiles in the Netherlands, the United Kingdom, Belgium, Germany, and Italy. In addition, the Pershing missile system, which was under a joint US-German control and not formally subject to the INF Treaty, was eliminated by an agreement between the United States and Germany (Missile, 2022).

Ukraine remains a member of the INF Treaty even though the United States officially withdrew from it on August 2, 2019, and Russia is in violation of it. Ukraine's accession to the INF Treaty makes it impossible to develop, manufacture and operate missiles with a range of more than 500 km, and, taking into account other international agreements, more than 300 km in the export version. Ukraine complies with the Presidential Decree and, accordingly, does not have any medium-range or shorter-range missiles. At the same time, the Russian Federation has been using missile weapons with a range of up to 5000 km since February 24, 2022, during the war against Ukraine (Halunko et al., 2023).

Thus, the INF Treaty, unlike the Missile Technology Control Regime, prevents Ukraine from developing and producing missiles with a range of more than 500 km for its own use and 300 km for export. This situation puts the Armed Forces of Ukraine in a pre-emptive disadvantage with the capabilities of the Russian Space and Rocket Forces, which have launch

vehicles (boosters) with a range of up to 5000 km and intercontinental missiles. Therefore, withdrawal from the INF Treaty is a matter of national security for Ukraine. And it requires some political will and courage from the Ukrainian Parliament, which it is lacking even during the second year of Russia's full-scale invasion of Ukraine, with constant strikes at civilian objects by the Russian missiles, and the deaths of thousands of Ukrainian civilians.

National legislation of the United States regarding restrictions on the development, manufacture, proliferation and use of missile weapons

The US laws of international importance primarily arose as a result of the search for methods to protect the US from some crises at home. Perhaps that is why the sanctions imposed by the US Treasury Department play a huge role among them. In the 20s and 30s of the twentieth century, the crisis of overproduction in an industrialized country was catastrophic. Every financial transaction in the world is controlled by the US banking system, which is an effective measure to prevent the undesirable proliferation of missiles and dual-use technologies. Including those that are not prohibited by any international agreements (Iglesias & González-Agote, 2023).

First of all, the sanctions and restrictions apply to dual-use goods. Dual-use items are the goods that have both commercial and military applications or contribute to the proliferation of weapons of mass destruction. Restrictions are imposed through the implementation of export controls. US EAR – Export Administration Regulations. The rules set forth in parts 730-774 of Title 15 of the Code of Federal Regulations (CFR) and issued by the US Department of Commerce to implement the Export Administration Act and other regulatory requirements. The EAR is amended by publishing decisions in the US Federal Register. There is a so-called EPCI – the Enhanced Proliferation Control Initiative. A presidential initiative announced by the United States in December 1990 that underlies within the US Department of Commerce's non-proliferation controls. A particular attention is paid to missile technology, as well as chemical, biological and nuclear weapons. Although the 1990 EPCI announcement covered both goods and end-use controls, the term is often used informally to refer to the EPCI provision that requires an export license based on the exporter's "knowledge" of the end-user or end-use purpose, or that the exporter has "been informed" (Compliance, 2021).

In case of violation of the US laws and international agreements, some sanctions may be imposed, for example, individuals and legal entities may be included in international lists – excluded/prohibited persons – special category citizens/special category terrorists. The sanctions are administrative and financial in nature (Technology, 2020).

Thus, on February 14, 2020, the US Federal Register published an official notification of the Bureau of International Security and Non-proliferation of the US Department of State regarding the introduction of restrictive measures against a number of foreign legal entities and individuals for violating of the non-proliferation regime (Regarding, 2021). Restrictive measures were imposed against some legal entities and individuals who, in violation of Section 3 of the US Non-proliferation Act, transferred or received goods, services or technology from Iran (since January 1, 1999), Syria (since January 2005) and North Korea (since January 1, 2006), that are subjects to the international control lists (Missile Technology Control Regime, Australia Group, Chemical Weapons Convention, Nuclear Suppliers Group, Wassenaar Arrangement) or that have a potential to be used in the development of weapons of mass destruction, cruise or ballistic missile systems.

It is noted that some of these goods, services or technologies are not included in the international control lists, but are subjects to the US national control lists. In particular, on February 3, 2020, the United States imposed restrictive measures, including against: "Kumertau Aviation Production Enterprise," Russia; – "Instument Building Design Bureau" (KBP), Russia; – "Scientific Production Association Mashinostroyeniya" (NPOM), Russia; "Eren Carbon Graphite Industrial Trading Company, Ltd.," Turkey (Concerning, 2020).

Thus, US legislation in terms of restrictions on the development, manufacture, proliferation and use of weapons is not formally applicable to Ukrainian businesses engaged in the development of launch vehicles(boosters). However, according to the legal custom in the field of missile technology, confirmed by effective coercion in the form of sanctions, and given that the United States is a very important major financial and arms partner (donor) for the Ukrainian people in the Russian-Ukrainian war, it is practically becoming the subject to unconditional implementation.

Domestic legal restrictions on development of tactical and strategic missile weapons in Ukraine

The Ukrainian legislation, when signing international agreements, implements these agreements at a state level. First of all, with regard to missile weapons. START I: The Strategic Arms Reduction Treaty between the USSR and the United States was signed on July 31, 1991 (Kimo, 2022). START II: The Treaty on the Further Reduction and Limitation of Strategic and Offensive Arms was signed between Russia and the United States on January 3, 1993. Ukraine was directly involved in the implementation of these Treaties. After declaring its independence, Ukraine inherited 17% (1656 units) of the USSR's nuclear heritage. According to the Almaty Agreement, Belarus, Kazakhstan and Ukraine pledged to withdraw all tactical Nuclear Weapons deployed on their territories to Russia no later than July 1, 1992.

In April 1992, the United States put forward a draft of the Additional Five-Party Protocol to START I, which was signed by all parties on May 23, 1992 in Lisbon and went down in history as the Lisbon Protocol. This document determined the succession of Ukraine, Russia, Belarus and Kazakhstan to the former USSR's obligations under the START I Treaty. In the Protocol, Belarus, Ukraine, and Kazakhstan confirmed their commitment to adhere to the Treaty on the Non-Proliferation of Nuclear Weapons as non-nuclear weapon states as soon as possible. In addition to the Lisbon Protocol, the Bush administration secured special unilateral statements from the presidents of Belarus, Kazakhstan, and Ukraine, in which they confirmed their countries' intention to become non-nuclear weapons states, accede to the Nuclear Non-Proliferation Treaty, and ensure the removal of strategic nuclear weapons to Russia (Treaty, 1968; Start I, 2022).

Ukraine's aspiration to have the status of a non-nuclear weapon state has been repeatedly confirmed in documents of the Verkhovna Rada: The Statement of October 24, 1991, which states Ukraine's intention to "accede to the Treaty on the Non-Proliferation of Nuclear Weapons as a non-nuclear weapon state," the Address to the Parliaments and Peoples of the World as of December 5, 1991, and the Resolution as of April 9, 1992. On October 25, 1993, an agreement was signed between Ukraine and the United States to assist Ukraine in eliminating strategic nuclear weapons and preventing the spread of mass destruction. On November 18, 1993, the Verkhovna Rada of Ukraine adopted a resolution on the ratification of the START Treaty and the Lisbon Protocol.

The Resolution stipulates that, in accordance with the limits established under the Treaty for the former USSR and principles of equality of all states – the successors of the former Soviet Union, Ukraine are obliged to reduce, with subsequent destruction, 36% of their carriers and 42% of their nuclear warheads of strategic offensive nuclear weapons located on their territories. On November 16, 1994, the Verkhovna Rada of Ukraine decided to accede to the Treaty on the Non-Proliferation of Nuclear Weapons. On December 5, 1994, the ratification documents under START I were exchanged. From that moment on, the Treaty had entered into force and its practical implementation by the parties began. On the same day, the documents on Ukraine's accession to the Treaty on the Non-Proliferation of Nuclear Weapons were handed over to the heads of the depositary states (On Ratification, 1993).

At the same time, the leaders of the United States, the United Kingdom, and Russia signed a Memorandum on Security Assurances for Ukraine, which sets out the obligations of the nuclear powers with respect to Ukraine's national security in accordance with the generally recognized principles of international law. On the same day, France, China, and the United Kingdom unilaterally provided security guarantees to Ukraine. Ukraine has fulfilled its obligations (Memorandum, 2014).The national legal requirements for the design and production of weapons, including combat missiles, are spelled out in the relevant Law on Defense Procurement and in special and martial law bylaws approved by the Government of Ukraine (On defense, 2020; On licensing, 2015).

It should also be noted that according to the Resolution of the Cabinet of Ministers of Ukraine No 392 as of April 23, 2001, Ukraine has established the institute of general designer to design some equipment for the defense and security needs of the state. This is the person authorized by the Cabinet of Ministers of Ukraine to ensure the implementation of a set of research, development and research and technological works related to the creation and modernization of samples of a particular type of weapons or military equipment or the most important systems of military equipment, automated systems, products and technologies of dual-use (On the approval, 2001).

It has significant legislative powers and organizational capabilities. In particular, he submits proposals to state customers for approval of executors and co-executors of product development and distribution of funds among them, technical specifications for research, development and research and technology works, reviews and determines some relevant technical specifications (certificates) for the products; controls the implementation of tasks for modernization of products created under his supervision and manufactured by enterprises regardless of their ownership; provides customers of research, development and experimental technological works at any stage of their implementation with reasonable proposals for revision (clarification) of the terms of reference (tactical and technical requirements); participates in the work of commissions on certification of products developed under his leadership (On the approval, 2001).

There are also certain simplifications for importing components to Ukraine for the production of weapons. After all, the situation changed dramatically after the start of the full-scale invasion of Ukraine by Russian-terrorist forces after February 24, 2022. Previously, business entities had to submit a large package of documents for registration with the State Export Control Service, but after the start of the large-scale invasion, one electronic application was sufficient enough. These can be business entities of any form of ownership, which after their registering with the State Export Control Service as entities engaged in the import of military goods are entitled to import them for the needs of the Armed Forces of Ukraine.

Charitable organizations can also do this, with the exception that they are not allowed to make a profit. The State Export Control Committee of Ukraine has registered more than five hundred entities that can import military and dual-use goods to Ukraine (Doluda, 2022). Thus, the Ukrainian government has created virtually all the necessary conditions for the design, testing, and production of short-range missiles. Ukrainian missile designers and manufacturers face virtually the same problem: lack of funding. For, all available public funds are currently used to provide financing to a million-strong Ukrainian army. Private Ukrainian and foreign investors and volunteers have not yet been convinced to invest in promising projects of Ukrainian missile designers and manufacturers.

Prospects for the creation of missile weapons in Ukraine and its legal regulation

The existing restrictions, in our opinion, should not be seen as a verdict on the Ukrainian missile program. The official missile program has been reviewed by the National Security and Defense Council of Ukraine. It is known that the deadline for its implementation has been postponed until 2031: NSDC Secretary O. Danylov said that the Council considered documents on the National Security Strategy of Ukraine and the Strategic Defense Bulletin, and that more than UAH 200 billion would have been allocated for missile weapons by 2031 (Ukraine, 2021). From the information obtained, it is known that Ukrainian developments fully comply with the restrictions of the INF Treaty. That is, Ukrainian missiles will never reach the aggressor at a distance of more than 500 km.

According to the authors, we should look for our own Ukrainian way to succeed. First of all, based on the study of the very purpose of the restrictions – to curb the proliferation of weapons of mass destruction: nuclear, chemical and biological. That is, strategic missile weapons in Ukraine may be different from weapons of mass destruction. The target for Ukrainian strategic missiles without range limitation shall only be the military targets. This should follow from the very purpose of the missiles: to destroy military decision-making centers (bunkers), warships, bases and munitions depots. The target can determine the design of the missiles, and they cannot be used in any other way.

An example is high-precision kinetic weapons that do not use explosives at all. In this case, Ukraine will not infringe anything. Such technical areas should be included in the Ukrainian missile program as strategic weapons to deter the aggressor, along with other traditional tactical means (Halunko et al., 2023).

And what about Ukraine's industrial and financial state groups? They do almost nothing by themselves in the field of effective modern military missile boosters and prevent private businesses from doing so.

An example of confirmation of this conclusion is the decision of the State Property Fund of Ukraine, which is forced to liquidate more than 1,200 unprofitable state-owned enterprises. On June 16, 2023, the State Property Fund of Ukraine reported that it had analyzed 2,364 enterprises currently managed by the SPFU. From them: 134 are strategic assets that will remain under state management; 288 are subject to privatization and are looking for investors; 664 are located in the occupied territories; 1278 are scheduled for liquidation or bankruptcy (Boytsun et al., 2023).

The recent reforms of public administration in the public sphere regarding production of Ukrainian weapons offer some hope for solving this problem. Thus, on March 21, 2023, the

Government of Ukraine established the Ukrainian Defense Industry Joint Stock Company by transforming the State Concern Ukroboronprom. The company will be responsible for managing the state's corporate rights in relation to business entities in the military-industrial complex of Ukraine (On termination, 2021; On the establishment, 2023).

It should be emphasized that the new entity in the form of a private joint-stock company, with its legal competence and political will, will be able to corporatize the inefficient state defense enterprises. This could theoretically create some conditions for the emergence of a new Ukrainian arms industry. However, the future statutory activities of the Ukrainian Defense Industry Joint Stock Company are not really aimed at stimulating of the development, testing, and production of Ukrainian weapons, in particular short-range ballistic missiles.

Thus, the main hope remains with private initiative, the Ukrainian (including diaspora) patriotic investors and volunteers. The development and production of Ukrainian strategic missile weapons to deter the aggressor should be entrusted on a private level with the support from the state, taking into account the experience, ability to communicate with the authorities, and critical thinking of citizens. Any high-precision weapon will be in demand on the global arms market, especially "the clean" weapons that are not weapons of mass destruction, which will provide revenue. Active Ukrainians should also have the opportunity to make history in Ukraine, in particular as the designers and manufacturers of missile technologies for effective deterrence of the Russian terrorist aggressor.

In our opinion, this possibility can be ensured at the legislative level by adopting annexes to the restrictive regulations on the creation of strategic missile weapons to deter aggressors that are not weapons of mass destruction. This should be done within the framework of the future and necessary social contract in Ukraine, which will guarantee its citizens well-being and prosperity of a rich country, peace, and personal freedoms.

Conclusions

The article analyzes the legal mechanism of arms trafficking and legal restrictions regarding the creation of missile weapons in the context of the Russian-Ukrainian war that began in early 2014. It has been proven that it is satisfactory for the design and production of ballistic missiles with a range of up to 500 km. After all, the current international, interstate and national legal regimes, although limiting certain types of missile weapons, provide a theoretical opportunity to produce and supply effective missile weapons to the Armed Forces of Ukraine. Although we cannot claim that the legislation in Ukraine in the area we are analyzing is perfect, it needs to be enhanced. However, the main reason why the Armed Forces of Ukraine do not have effective Ukrainian missiles is the lack of political will to withdraw from the INF Treaty and create a new investment paradigm. The current investment paradigm focuses domestic elites (the Ministry of Defense of Ukraine, national industrial financial groups, and volunteer organizations) on purchasing weapons from various foreign manufacturers rather than investing in production of Ukrainian weapons, including the missiles to deter the russian aggressor.

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Public Administration of Space Activities of Individual Countries of the World at the Present Stage

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The article analyzes the public administration of space activities in such countries as Australia, Brazil, South Korea, People's Republic of China, and the United States of America. Regulatory legal acts intended to regulate the space activities of some European Union member states were also analyzed. Comparing the legislation of different countries with different legal systems allowed us to state that there are serious obstacles on the way of combining the efforts of different countries in the field of space activities due to the national and cultural specifics of space exploration by representatives of different peoples. Therefore, this specificity determines the priorities for each specific country in the space sector. It is found out that at the present stage, global space activities are faced with the task of active development of public-private partnership, while the characteristic features for this area are not clearly defined. There is a need for a conceptual understanding of the role and place of private operators of commercial space services. The problem of scientific justification of rational forms of intra-industry

and intersectoral integration and cooperation in the context of the new space doctrine is waiting for its solution.

Keywords: global administration, space security, global space administration, integration, space activities, space doctrine, licensing, public administration, cooperation, standardization.

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Introduction

The gradual advance of humanity into space is of strategic importance for its evolution. The beginning of the development of infinite areas and space resources, the possibility of humanity reaching a new superglobal level of security and sustainable development no longer seem completely unattainable, for the first time they become an important practical direction for its promising accelerated development (Soroka, 2020). In a global sense, outer space was regulated by international law. This meant that all countries and actors had to work together to develop effective space legislation for future needs. However, since the recognition of outer space as an object of regulation, the national legislation of a particular country has also begun to gain momentum.

At the present stage, at least 26 States (14% of the members of the United Nations) regulate space activities (A/RES/70/224, 2015). However, despite the fact that standards and rules for space activities are being created at the national level, problems arising during its implementation (space debris, the fall of space bodies, the arms race, etc.) require joint efforts on the part of modern states. Therefore, the establishment of both national and international standards, which are designed to provide reliable and understandable rules for the implementation of space activities, is an extremely important area of legal regulation of the space industry. After all, by studying the specifics of the legal support of space activities of an individual state, independent institutions can improve their own space infrastructure and, borrowing foreign experience, create new, separate, or joint space projects.

With the appearance of a large number of private actors, the importance of regulating commercial space activities is now quite significant. State control and supervision of commercial space activities is essential for the protection of public safety, property and the environment and for the fulfillment of the state's obligations under international law. Taking this into account, it is relevant to analyze the licensing systems of UN member states that have adopted national regulatory legal acts in the field of space activities, based on the following criteria: legal basis; status of the licensing authority; licensed types of space activities; license requirements and conditions; terms of issuance and validity of licenses; consequences of violation of license requirements and conditions; license control.

Features of Public Administration of space activities in individual countries

Australia

The Australian Space Agency was established under the Ministry for Industry and Science to coordinate civil space activities in the government and support the growth and transformation of

the space industry on July 1, 2018 (About, 2023). The same year, the Australian space (Launches and Returns) Act (Space, 2018) was passed with the aim of: a) establishing a system to regulate space activities carried out either from Australia or by Australian citizens outside Australia and regulating the launch of high-power rockets in Australia; b) ensuring a reasonable balance: 1) between removing obstacles to participation in space activities and encouraging innovation and entrepreneurship in the space industry; 2) between the safety of space activities and the risk of harm to people or property as a result of space activities; c) fulfilling certain obligations of Australia under the UN outer space treaties.

It was from this time that the public administration of Australian space activities began.

According to the stated law, for the implementation of space activities in Australia, the following types of activities require approval: launching a space object from Australia; returning a space object to Australia; launching a space object abroad (for Australian citizens with a share of ownership); returning a space object abroad (for Australian citizens with a share of ownership); operating a launcher in Australia; launching a powerful rocket from Australia (Regulating, 2023). Therefore, space activities on the territory of Australia, as well as if such activities are carried out by Australian citizens outside Australia, are subject to the license regime.

In Australia, launching a space object is defined as launching an object from an area to an altitude of more than 100 km above sea level or attempting to do so. A launch permit is also required to launch a space object or a specific series of space object launches from a launch facility located in Australia. Permission to launch is granted after the licensing authority has satisfied itself that the applicant demonstrates its competence in carrying out the launch, and that such actions will not cause significant damage to public health or property or public safety. The launch of a space object must not be contrary to Australia's national security, foreign policy, or international obligations, and the applicant must meet the necessary financial and insurance requirements (Space, 2018).

The Australian Civil Space Strategy 2019-2028 was adopted to address the challenges of fierce competition and the rapidly growing space sector, while increasing scale and removing market barriers (Australian, 2019a). The strategy defined four strategic pillars: "Open the door internationally; develop national capability in areas of competitive advantage; ensure safety and national interest are addressed; and inspire and improve the lives of all Australians" (Australian, 2019b: 4). The strategy has set an ambitious goal of creating 20,000 jobs in Australia's space sector by 2030.

In addition, it should be noted that Australia has created a space infrastructure fund worth 19.5 million dollars (Space, 2023). In October 2022, the government announced that it would spend almost 1.2 billion dollars on locally produced satellites (Seidel, 2022). Australia is also building its own spaceports (Goswami, 2023).

Brazil

Brazil also regulates space launches from its territory. The central body in the field of space activities is the Brazilian space agency (Agencia Espacial Brasileira) (Agência, 2023), which is part of the Ministry of Science, Technology, Innovation and communications, but reports directly to the president of Brazil (Law, 1994). The Brazilian space agency is a public institution responsible for shaping, coordinating and implementing Brazil's space policy. The Brazilian space agency is responsible for updating the National Space Policy and coordinates and monitors the National Space Programme.

To perform its duties, the Brazilian space agency has an advisory High Council consisting of representatives of various ministries and departments involved in the space sector, as well as members of the scientific community and the industrial sector (Sistema, 2020). In order to implement the space program and international treaties, the country's leadership adopted a joint order signed by the Minister of Science, Technology and Innovation, the Minister of Development, industry and foreign trade, which approved regulations on the procedures and definition of requirements necessary for the application, evaluation, sending, control, monitoring and inspection of licenses for space operations in Brazil (Portaria, 2014). In accordance with this regulation, the Brazilian space agency issues licenses for space activities, controls, monitors and inspects licensees and their activities. It can also initiate administrative proceedings for violating licensing requirements and recommend applying sanctions to violators. Administrative sanctions that can be applied to the licensee in case of violation of the license terms are as follows: warning, temporary termination of the license, and cancellation of the license (Mkrtchian et al., 2019). However, the application of these sanctions does not exempt from civil or criminal liability if there are grounds for this.

A license to carry out space activities is granted to individuals, legal entities with a headquarters or representative office in Brazil that meet the technical and financial requirements for the period specified in the act itself, taking into account the period of depreciation of investments that will be applied by the licensee. Documents submitted for obtaining a license consist of several blocks: 1) legal block (documents confirming the legal status of the applicant are submitted); 2) Technical block (documents related to the technical side of the activity, description of the application, confirmation of the technical qualification of performers, certificates of conformity, etc. are submitted); economic and financial block (documents confirming the financial viability of the declared activity, insurance contract to cover possible losses to third parties in accordance with the degree of risk of the activity to be carried out, etc. are submitted); fiscal block (documents confirming the tax status of the subject, registration with the tax authorities, payment of all fees and taxes are submitted) (Portaria, 2014).

South Korea

South Korea has not yet established a space agency. Public administration of space activities is carried out by the Ministry of Science and ICT and a special body – the National Space Committee of South Korea, which reports to the president of the country. South Korea's space policy is based on the National Space Program and three space acts (Kim, 2012). Korea's space Relations Act is divided into three parts: (1) The Aerospace Industry Development Promotion Act (Aerospace, 1987), (2) The Space Development Promotion Act (Space, 2005)[12], and (3) The Space Damage Compensation Act (Act, 2007).

South Korea's space policy is based on the short, medium- and long-term national basic plan for Space Development. The long-term national basic plan is designed for 20 years and defines the long-term orientation and goals of space development (Kim, 2012: 15). The first one was adopted for 1996-2015 (An, 2020). The medium-term plan is adopted for five years and should contain the following points: 1) the purpose and scope of the policy for the development of space activities; 2) organizational structure and development strategy; 3) implementation plan; 4) plans for improving the infrastructure necessary for the development of space activities; 5) investment planning for obtaining financial resources necessary for development; 6) plans for training specialists; 7) plans for international cooperation; 8) guidelines; 9) issues related to

the use and management of space objects; 10) practical programs that use the results of space activities, such as satellite information, etc.; 11) other provisions defined by the Presidential Decree, on promoting the development of space activities, the use and management of space objects (Space Development, 2005).

Therefore, according to the requirements, a person seeking to engage in space activities must first obtain a license from the Ministry of Science and Technology of South Korea. The license is issued for: launching from the territory or from objects within the territory of South Korea or objects under its jurisdiction; launching in a foreign country using a space rocket vehicle owned by the Korean government or citizens of South Korea. When issuing a license, the Minister must take into account the purpose of launching, managing vehicle safety, and the existence of a liability insurance contract (Space Development, 2005). Anyone who wants to get permission to launch space rocket vehicles insures such activities. Third-party liability insurance should be one that can compensate for damage that may occur due to space accidents. The minimum amount of third-party liability insurance is established by decree of the Minister of the Ministry of Science and Technology.

Like other leading space countries, South Korea has launched its space programs primarily through government research and development. Although South Korea began its Space Development Program much later than other space countries, it appears to have made significant progress in a relatively short period of time, including the development of satellites using local space technologies, Korean Space Launch Vehicles (KSLV-I, II) (Ahn, 2019). With regard to National Space Legislation, Korean space acts, for the most part, implement most of the elements recommended by the UN General Assembly. To improve coordination between stakeholders, it is planned to create a national space agency next year.

The People's Republic of China

Public administration of space activities in China is carried out by the Commission of Science, Technology, and Industry for National Defense (SASTIND) (State, 2023), which is under the direct supervision of the Ministry of Industry and Information Technology. As an administrative and regulatory body, SASTIND serves the needs of national defense, military forces, the national economy, and military organizations (State, 2023). COSTIND controls most of the defense industry as the main administrative body of China's national space industry and civilian space activities. The adoption of comprehensive administrative regulation of outer space was one of the highest priorities in the late 1990s. However, his legislative efforts were limited.

As part of COSTIND, the China National Space Administration (CNSA) (China's, 2023) was established on April 22, 1993, in accordance with the decision on the structural reform program adopted by the State Council of the National People's Congress of the eighth convocation. Its main responsibilities are: signing state cooperation agreements; representing China in international organizations and events; and working with foreign national space agencies (Peng, 2023).

The analysis of China's regulations on registration and licensing of space activities makes it possible to state that they apply a minimalistic approach to fulfilling China's obligations under international treaties (Ma & Soroka, 2020). Thus, Interim Measures on the Administration of Permits for Civil Space Launch Projects (Interim, 2002) were adopted to introduce a licensing regime for certain types of space activities by private space companies in China.

Both physical and legal licenses can be obtained. No later than 90 days before the scheduled launch, a package of documents approved by the licensing measures is submitted to SASTIND. To obtain a license, the applicant will need to ensure that the draft meets a number of requirements, in particular: comply with national and state laws, especially those related to state secrets; the activity should not threaten China's national security; it should not act contrary to China's international obligations; it should not threaten public safety (Soroka, 2020). In addition, the applicant must show that they have the appropriate financial and technical potential to implement the project. The license terms require the licensee to enter into an insurance contract to cover losses to third parties, as well as insurance to cover losses for damage or destruction of a space object that will be launched (Interim, 2002).

In China, Space insurance services can only be provided by national providers. In particular, two companies have played an important role in promoting space insurance in China, namely people's Insurance Corporation of China (PICC) (The People's, 2023) and China Pacific Insurance Group (CPIG) (About, 2023). The applicant must contact insurance companies in China to determine which policy must be purchased to obtain a license. In accordance with the regulations of the People's Republic of China on the launch and operation of space objects and the implementation of other activities in outer space (An Ordinance, 1997).

So, from the beginning of the creation and further improvement of the socialist system and market economy, the development of space activities in China was engaged in the state. And as indicated in the first White Paper (2000), the state managed space activities through macro-control (White, 2000). In other words, the role of the state in the development of the space sector was and remains the leading one.

United States of America

In the United States of America, The Commercial Space Activities Act of 1984 (CSLA) (Chapter 509, 2011) authorized the Federal Aviation Administration (FAA) to issue licenses for space activities. The Federal Aviation Administration is the administrative body that issues licenses for commercial space activities, as well as monitors and supervises compliance with license conditions. Management is carried out by the director, who is appointed and removed from office by the US Secretary of Transportation (Chapter III, 1986). The FAA was created to protect the interests of US citizens, property, and national security during space activities, as well as to encourage commercial space transportation (Licenses, 2023). These rules do not apply to the activities of federal agencies such as NASA, and do not regulate the launch of so-called "amateur rockets." A US citizen or legal entity registered in the United States can apply for: 1) a launch license that allows the licensee to perform only those launches that are listed in the license (special license), 2) a launch operator license, according to which the licensee can perform any launches that fall under the broad parameters described in its license (operator license) (Chapter III, 1986).

A special launch license allows the licensee to perform one launch or a specified number of identical launches from a single spaceport. The launch vehicle for each authorized launch should be the same, and the launch parameters should not pose any problems to public safety or create other problems that may threaten the national interests of the United States. The licensee's permission to conduct launches is terminated upon completion of all launches authorized by the license, or upon expiration of the validity period specified in the license, whichever comes first. The launch operator's license allows the licensee to launch from the specified launch pad using

the same family of launch vehicles that carry certain classes of payloads within the range of launch parameters defined by the license. Initially, the operator's license was issued for two years. In accordance with the new section 415.3 (b) – for five years from the date of Issue (Chapter III, 1986). The ability to issue a launch operator license, as opposed to requiring a launch license for each launch (special license), has advantages for both the licensee and the FAA. Although preparing applications and verifying the launch operator's license will be more than for a special license, using this license class will ultimately reduce costs and improve efficiency for licensees by reducing the number of applications owned by the company. In this regard, the longer the license validity period, the more important role monitoring of requirement compliance plays, which allows the FAA to provide safety control over how the licensee fulfills its obligations.

The licensing process consists of several stages: pre-application consultation; policy review and approval; safety review and approval; payload review and determination; financial responsibility determination; environmental review; compliance monitoring. According to the FAA, 450 licensed launches were performed in the United States (Licenses, 2023).

Thus, at the present stage, the US policy in the field of space activities has taken shape in an independent and significant sphere of national policy and international relations. The long-term prospects of the country's development, its position in the world, success in global competition, etc., largely depend on it. The crisis of the 2000s led to a rethinking and reform of space programs and space policy and the development of a new space doctrine. The main principles of the new doctrine were: reducing manned projects and, giving preference to automatic flights; reallocating areas of responsibility between NASA and the private commercial sector. As a result, the federal sector is responsible for developing strategic directions of state policy and supporting basic space research, while the private sector is responsible for manned flights and scientific and practical use of the Earth's orbit.

The main mechanisms of national regulation of space activities of the United States are: 1) state space policy and implementation of space programs; 2) development of commercial opportunities, search and promotion of commercial use of outer space (establishment of legal bases for space trade, transportation, space commercialization management); 3) allocation and application of incentive measures in the form of awards, grants for training, scholarships; 4) licensing, insurance; 5) interdepartmental coordination of civil and military administration; 6) cooperation of the United States with other countries and organizations in this area, etc.

European Union

The Austrian federal law on space activities, adopted by the National Council on December 6, 2011, came into force on December 28, 2011 (Austrian, 2011). It applies to space activities carried out: on the territory of Austria, on board ships or aircraft registered in Austria. Space activities can be carried out by an individual with Austrian citizenship or legal entities registered in Austria. A permit for space activities is issued by the Austrian Minister of transport, innovation and technology if the applicant proves the necessary reliability, capability and experience to carry out space activities, as well as Enters into an insurance contract that covers a minimum amount of 60,000,000 euros for the insured event. In addition to the requirements that are usually imposed on the applicant for a license to carry out space activities, he must provide information on existing measures to prevent the creation of space debris, as well as other documents that are listed in the decree of the Federal Minister of transport, innovation and technology in compliance with the above-mentioned federal law on space activities (Regulation, 2015).

The Netherlands has also adopted a number of space regulations. In accordance with the rules on space activities and the creation of a register of space objects (the Law on space activities) (Rules, 2006). The Netherlands requires licensing the launch or return of space objects, management of space objects performed from its territory or from a Dutch ship (Rules, 2006). The license is issued by the Ministry of Economic Affairs after verification of the submitted documents and circumstances specified in the Law on space activities. The application may be submitted by a citizen of the Netherlands or a legal entity registered in its territory. The license may be withdrawn or revoked in case of violation of the license terms.

In France, according to the law, it is also necessary to obtain a license to carry out space activities (Loi, 1961). Applicants for a license include: 1) launch entities, i.e., those who launch from French territory or from an object under the jurisdiction of France, or those who plan to return the object to the national territory or to an object under the jurisdiction of France; 2) a French operator, regardless of where the launch takes place; 3) a French citizen or a corporation with headquarters in France, an operator or not, launching or managing a space object; 4) a previously authorized subject of space activity which, in accordance with French law, wants to transfer control or command of a space object (Loi, 1961).

Consequently, in the EU member states, public administration of space activities mostly has common features. To launch or return space objects or manage space objects, it is necessary to obtain a license; both individuals and legal entities can obtain a license to carry out space activities. Only the public administration body that regulates these issues and carries out-licensing activities is distinguished.

Conclusions

All of the above makes it possible to formulate the following conclusions regarding the public administration of space activities in different countries:

1) The institution of licensing is a natural and necessary measure for regulating and supervising commercial space activities of the private sector;

2) A number of different issues are subject to settlement, in particular, the launch of objects into space and their return from space, the operation of the launch or re-entry site and the operation and management of space objects, etc. Separately, it should be pointed out that states have obligations to decide and monitor the activities of non-governmental organizations in outer space, as well as establish administrative and legal mechanisms for regulating national commercial space activities;

3) Of all the countries of the world, only 26 have adopted regulatory legal acts in the field of commercial space activities. National Space legislation can be contained in single acts (Belgium, Brazil, Chile, etc.) or in a combination of national legal documents (Argentina, Austria, Canada, France, etc.). Some countries regulate space activities at the level of bylaws (China, India). In addition, some states have adapted their national legal frameworks to meet specific needs and practical considerations regarding the scope of space activities and the degree of participation of the commercial sector (United States, Luxembourg, etc.);

4) Most countries require subjects of commercial space activities, in addition to obtaining a permit to carry out such activities, to obtain a license to carry out certain types of space activities. Such licenses are issued for one-time launch (return of a space object) or series (operator's license); management of a space object; operation of launch sites (spaceports). Most countries allow both citizens and legal entities to participate in commercial space activities (for example, Ukraine allows only legal entities).

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